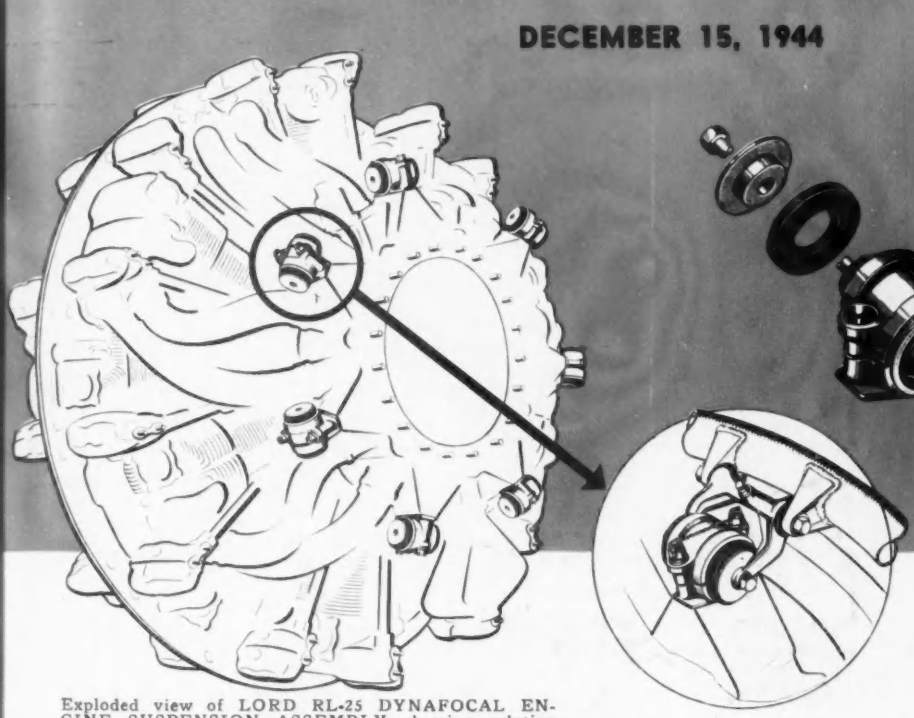
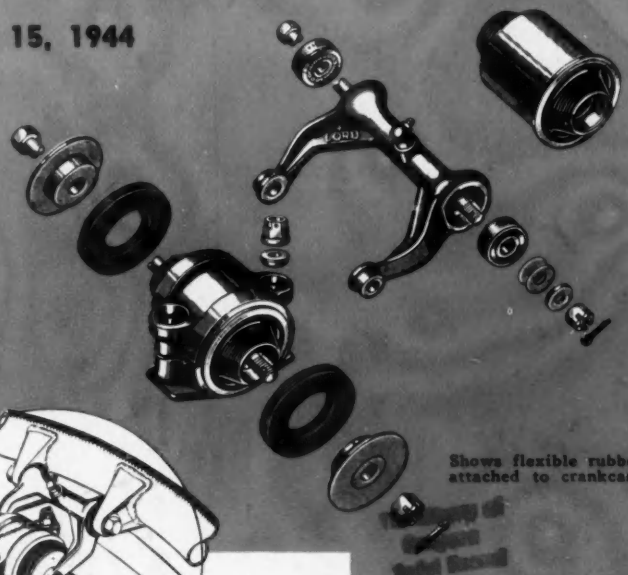
AUTOMOTIVE and Aviation INDUSTRIES

DECEMBER 15, 1944



Exploded view of LORD RL-25 DYNAFOCAL ENGINE SUSPENSION ASSEMBLY showing relation of Timken Bearings. LORD Assemblies are used to support flexibly Wright R-2600 radial aircraft engines.



Shows flexible rubber units attached to crankcase.

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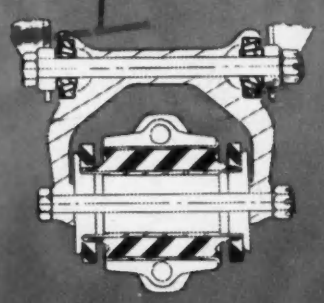

Completed assembly after engine is hooked to mounting ring. Due to angularity of links, virtual center of gravity support is achieved, and flexibility of mounting assembly allows free movement in all directions about engine C. G.

Timken Bearings HELP LORD

DYNAFOCAL ASSEMBLIES ISOLATE ENGINE VIBRATION

"In the Lord link-type Dynafocal suspensions," writes the manufacturer, "Timken Bearings are used because of their high load capacity, compact size and low friction."

"Radial aircraft engine suspensions require proper relation of spring rates in the assembly to provide a virtual suspension at the engine's center of gravity. Proper spring rate *demands* that the assembly be soft in torsion, stiff radially and very soft normal to the link. This last condition is achieved because the links can rotate on Timken Bearings at one end and because of the low torsional stiffness of the mounting rubber section on the opposite end."

Why not assure *yourself* of all the many Timken Tapered Roller Bearing advantages, such as maximum radial and thrust load carrying capacity, adjustability and freedom from friction? Write us. Our engineers will be glad to make specific recommendations. The Timken Roller Bearing Company, Canton 6, Ohio.

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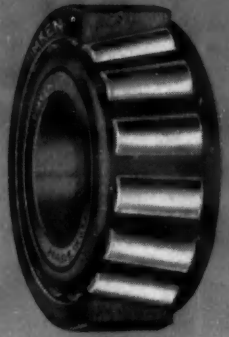

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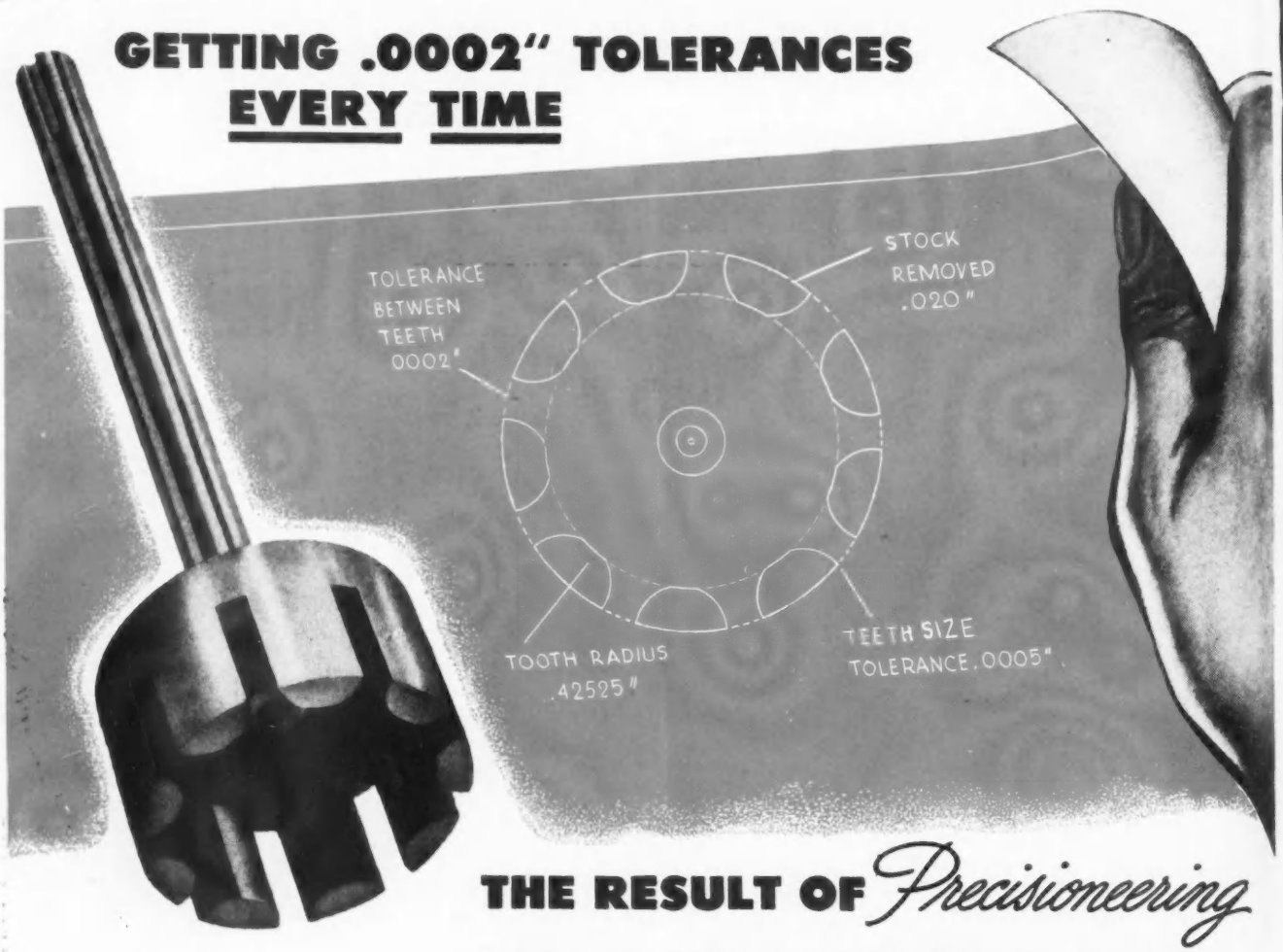
GETTING .0002" TOLERANCES EVERY TIME



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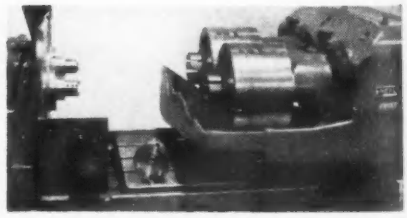
Nine teeth on this pump rotor are precision-turned along the entire length to a radius of .42525" on a two-station Heald No. 47A Bore-Matic with rotating box type quills and a rotary indexing work fixture. Material is cast iron and .020" of stock is removed. Tooth radius is held to .0005", space between teeth to .0002". Borized finish requires no supplementary finishing.



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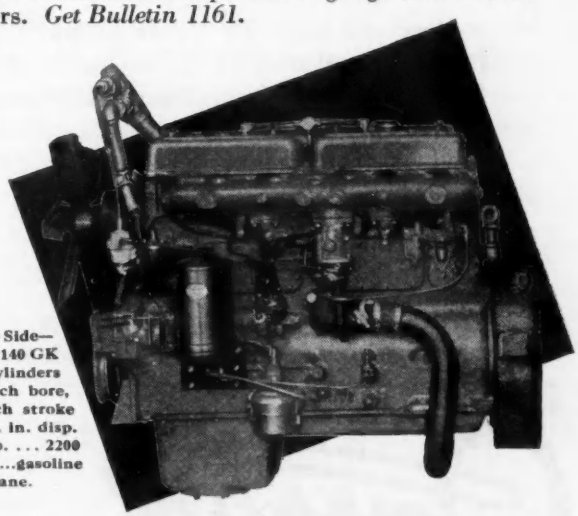

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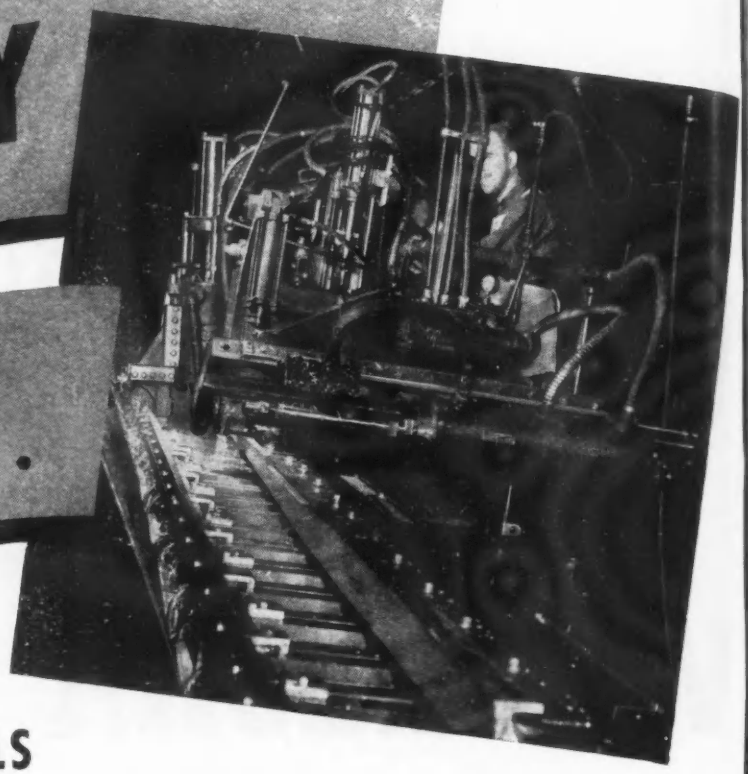

FOR TOMORROW'S METALS

Experts agree that the "light metals" are about ready for the "big time." Working the "metals of motion" presents no problem if you know about methods already made possible by Onsrud high speed milling machines.

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High speed milling of nonferrous materials is a technique with whose development Onsrud Machine Works, Inc., has been intimately associated from the start. Out of that experience has already come the famous Onsrud Automatic Contour Miller to make high speed production milling of aluminum alloys a reality. Keep an eye on Onsrud while you are watching light metal progress.

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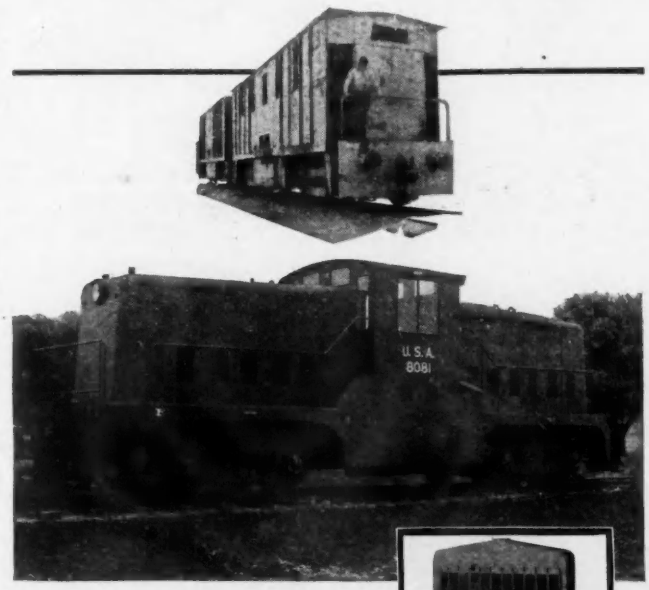

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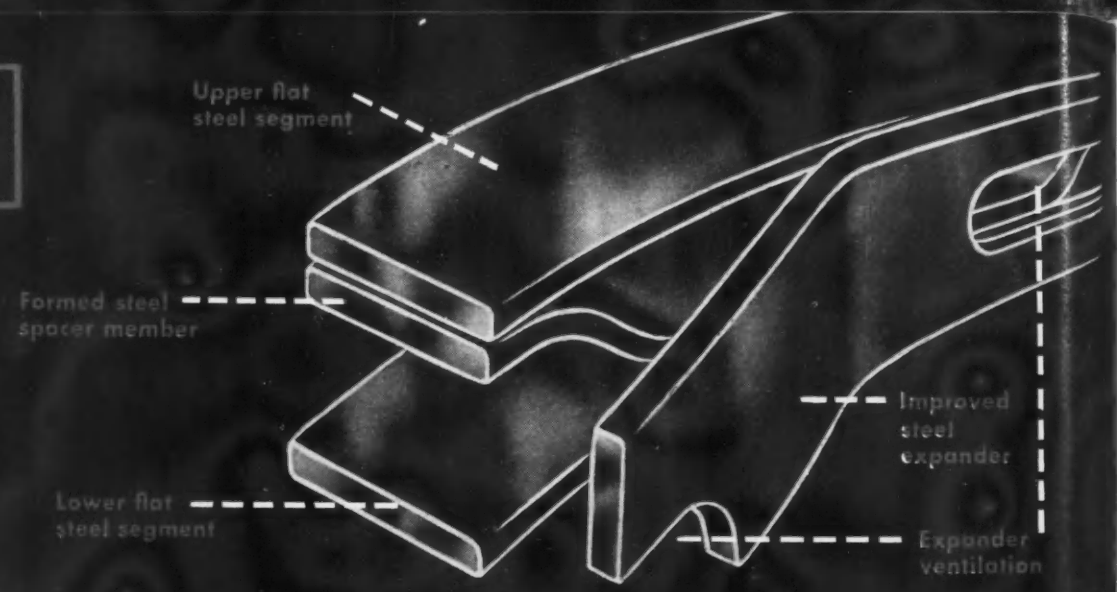

oil controlled even in badly worn engines!

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Wear in an engine—the unavoidable result of long, hard service—requires special engineering of service parts. Cylinders worn out-of-round and tapered must have piston rings designed to meet these conditions.

The Muskegon type XMS oil ring is specially designed for exactly this service. It consists of two narrow cam-shaped steel segments and a precision formed steel spacer member, all of which contact the cylinder wall, and improved, ventilated steel expander member.

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Whatever the piston ring problem may be there is a correct Muskegon type. Ask Muskegon engineers.

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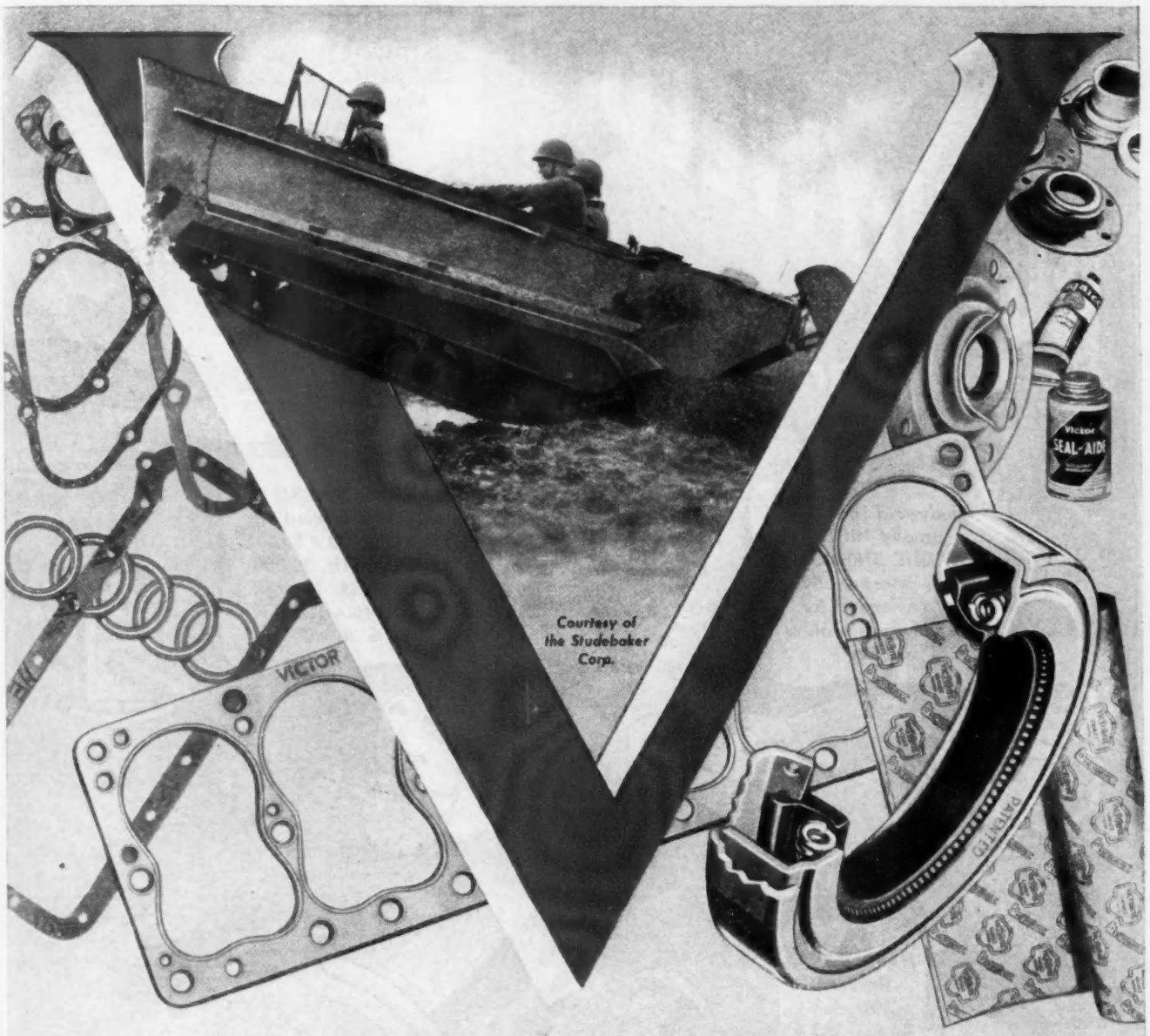

AND NOW IT'S THE WEASEL

The major portion of Victor gasket production since before Pearl Harbor has gone into automotive war equipment, such as the Studebaker Weasel, heavy trucks, landing boats and Jeeps. After V Day, improved and expanded facilities will be available for peacetime needs. Victor Manufacturing and Gasket Co., P. O. Box 1333, Chicago, Illinois, U. S. A.

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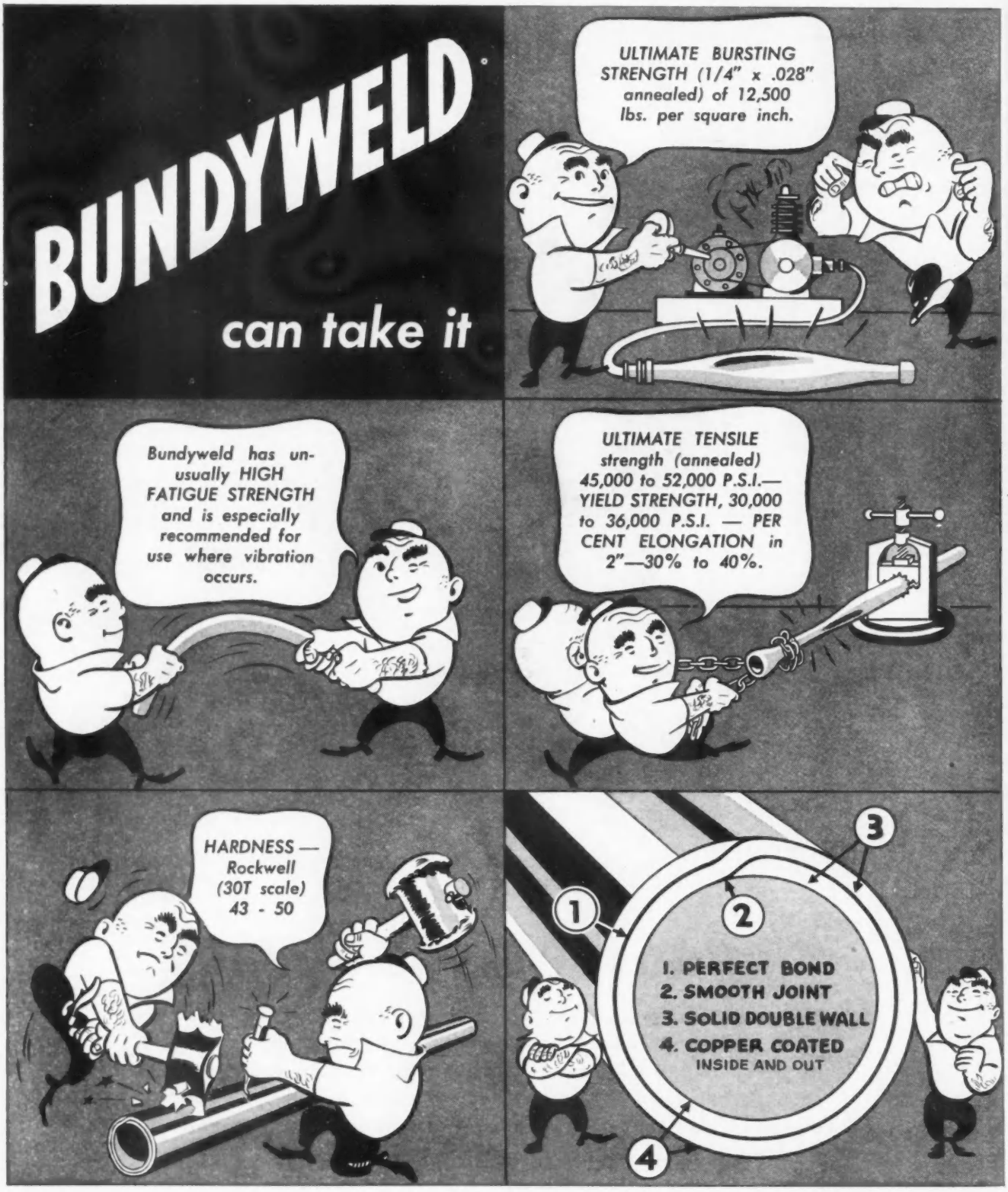
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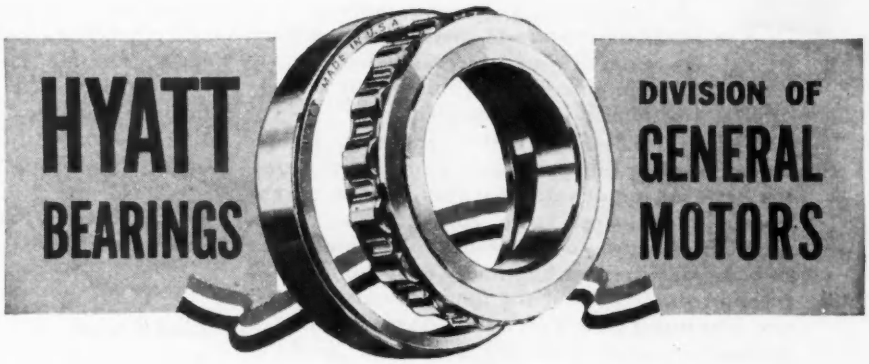

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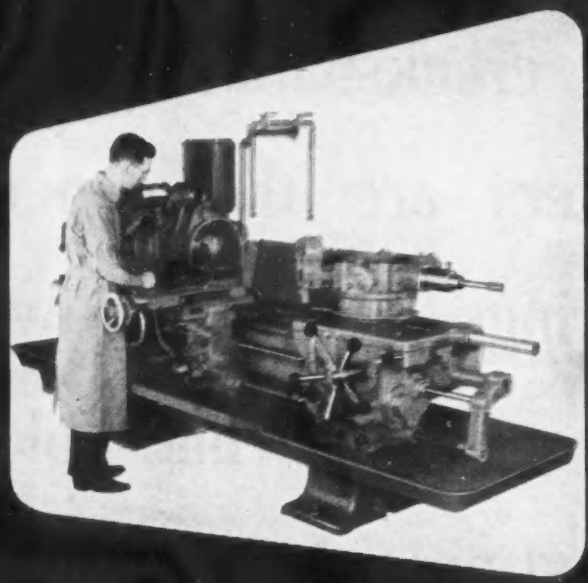

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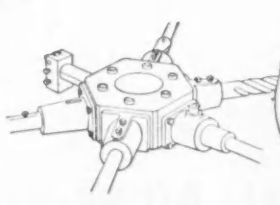

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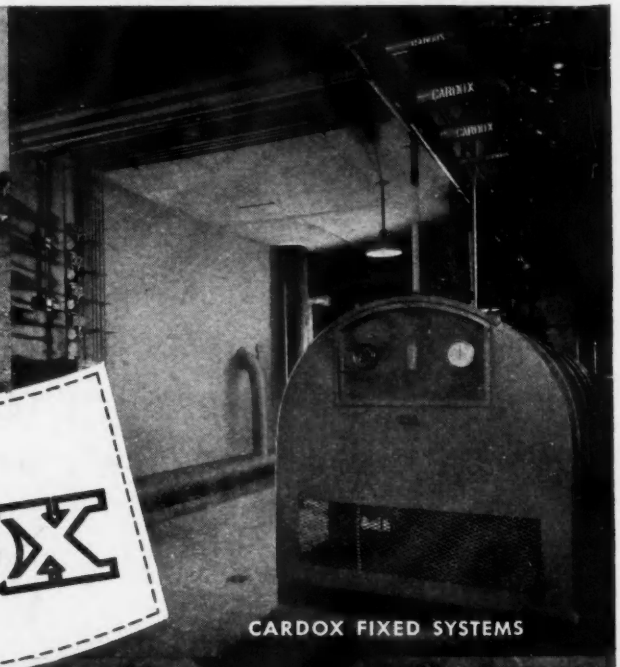

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FIRE PROTECTION By CARDOX

CARDOX AIRPORT FIRE TRUCK

In and around America's vital war plants . . . on our big and busy military airfields . . . fire protection is provided by Cardox Fire Extinguishing Systems, Fire Trucks and Airport Fire Trucks.

Each is a highly specialized fire extinguishing tool . . . exactingly engineered to do a specific job quicker and more effectively than it has been done before. But all Cardox Systems and Mobile Units have one outstanding characteristic in common: *Cardox Engineering in the application and control of carbon dioxide, stored at 0°F. and 300 p.s.i. in a single Storage Unit containing from ¼ to 125 tons of fire-destroying Cardox CO_2.*

For Cardox has given the recognized advantages of carbon dioxide a new and broader scope of fire extinguishing performance. Because of this, these advantages can be applied equally well to small or *very large* fires through *mass* application of Cardox CO_2, released in *pounds* or *tons*.

The efficiency of Cardox Systems and Mobile Units in giving fast-acting, nondamaging carbon dioxide *enhanced extinguishing* performance is made possible by Cardox methods of control and application that give Cardox CO_2: (1) Uniform extinguishing characteristics regardless of plant or atmospheric temperatures; (2) Availability in ample quantity for uninterrupted protection and mass application at high rate; (3) High CO_2 "snow" yield for increased cooling effect; (4) Effective projection through relatively great distances.

On the basis of this performance Cardox has been given many of the toughest fire protection assignments—*all over the country*. Find out how through practical cooperation Cardox and its engineering staff can assist you to make your planned fire protection more effective. Write on company letterhead for Bulletin 4124.

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RING GAGE ACCURACY AT PRODUCTION RATES BY

MICROHONING

Microhoning offers to industry a new tool with which to meet post-war demands for better products at moderate cost—at possibly increased labor rates. A process of final machining, **Microhoning now assumes added responsibility—it removes from .010 to .030 stock under automatic sizing control. By providing ring gage accuracy *at production speeds*, it offers a way of using the second formula to achieve profitable post-war prices.**

It will correct error in bores, or on cylindrical or spherical surfaces, either before or after heat treating—providing form and size accuracy to "tenths." In removing stock, it does not cause heat cracks. By removing distorted surface metal and cracks left by previous operations, it eliminates two of the most frequent causes of fatigue failure.

This modern abrading process also provides any desired surface finish. It is not limited in its application to iron and steel products, but is in successful operation on a wide variety of non-ferrous metals, such as silver-lined bearings and chromium-plated cylinder bores.

Micromatic Hone Corporation builds machines for Microhoning as required in industrial production. These range from tool room type machines arranged to handle a wide variety of work to multiple spindle production machines which provide accuracy and high speed on production parts.

Microhoning can be very useful in your post-war production. Let our engineers discuss applications with you.

MICRO MATIC

MICROMATIC

MAKERS OF

New MICROMATIC HYDROHONER MODEL 705

MULTIPLE SPINDLES

AUTOMATIC ROTARY INDEXING

MICROSIZE CONTROL

MICRODIAL FEED CONTROL

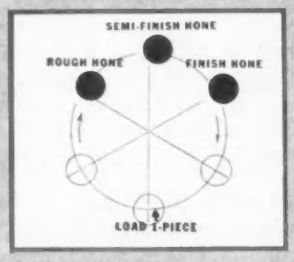
This new Micromatic Hydrohoner is a high speed production model, designed to produce large quantities of high precision parts. It may be used in multiple or progressive honing within uniform size limits (maximum) of .0003", on parts such as these:

Diesel Fuel Injectors, Pinion Gears, Precision Bearings, Bushings, Compressor Housing Bores, Piston Pin Holes, Connecting Rods, Valve Guides, Hydraulic Pump Bores, Rocker Arms, Ceramic Tubes, Valve Bodies.

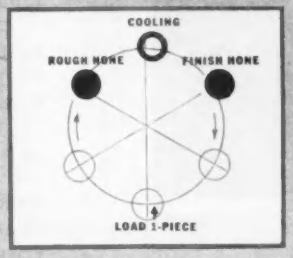
Variations in error which usually occur in production are corrected in straight run honing. Uniform size is automatically generated through the Micromatic Microsize Control—a positive, fully automatic method of generating uniform size.

Each spindle has its own individual Microsize Control, so that any desired combination in multiple or progressive honing may be set up.

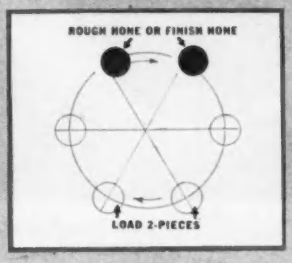
Three typical set ups are illustrated below:



THREE OPERATIONS. Progressive Honing Operations permit maximum stock removal per unit of time. Usually recommended for maximum stock removal ranging from .007 in ¼" diameter bores to .010 in 1" diameter bores.



TWO OPERATIONS. Progressive Honing Operations permit medium amount of stock removal per unit of time. Usually recommended for maximum stock removal ranging from .0035 in ¼" diameter bores to .005 in 1" diameter bores.



ONE OPERATION. Multiple Honing Operation permits conventional amount of stock removal per unit of time. Usually recommended for maximum stock removal ranging from .0005 to .0015 for hardened parts (55 Rock. C or harder), .001 to .003 for soft or medium hard parts, in bores from ¼" to 2" diameter.

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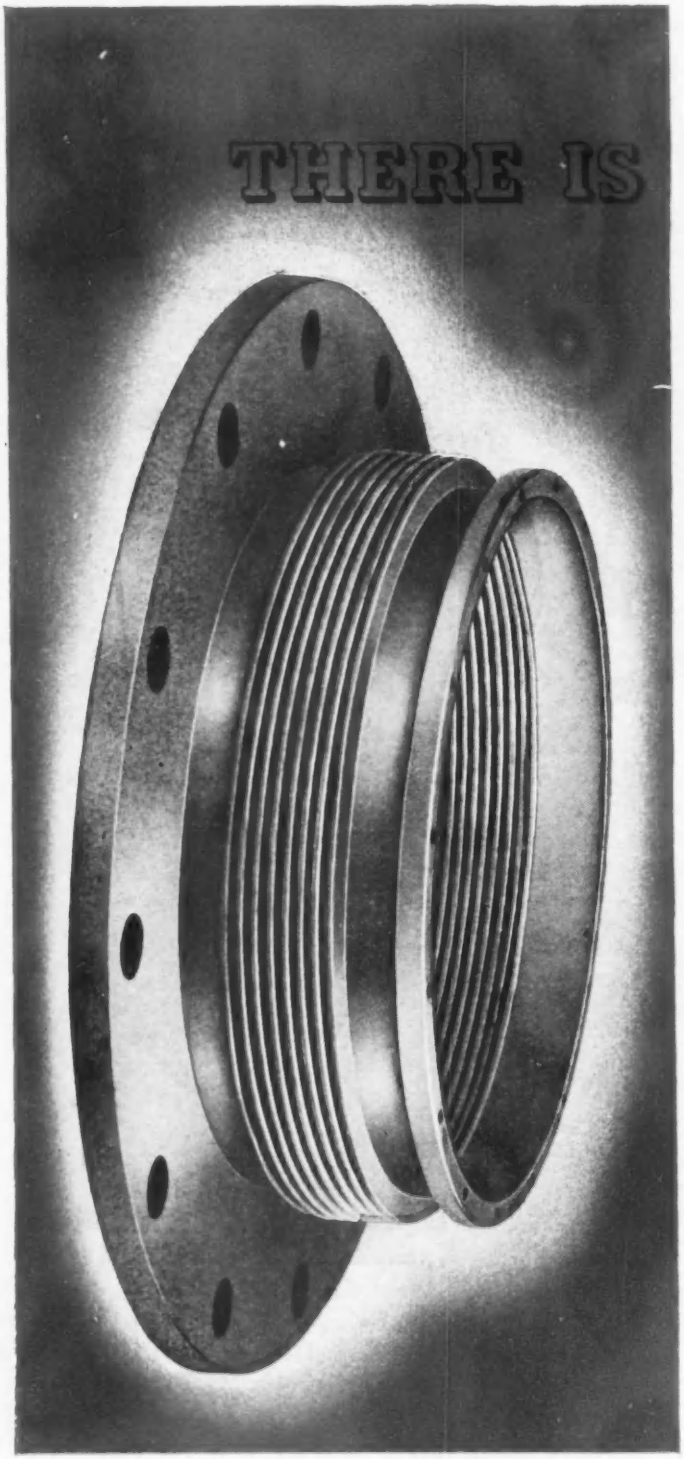

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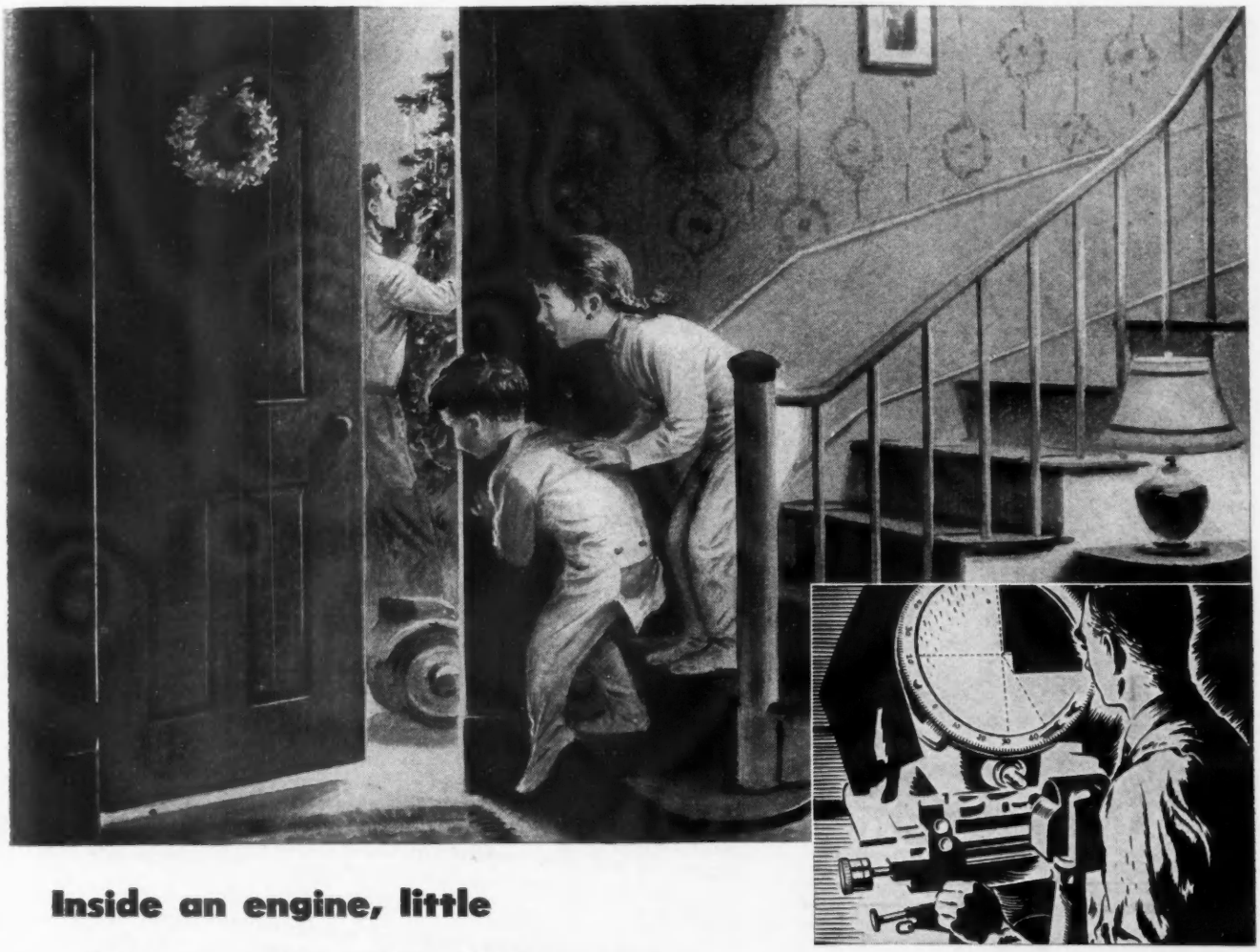

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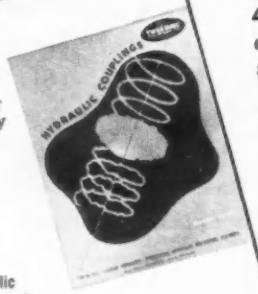

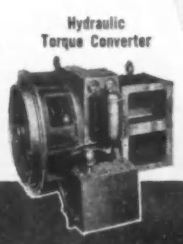

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AUTOMOTIVE and AVIATION INDUSTRIES

Volume 91 December 15, 1944 Number 12

The Navy Looks to the Automotive Industry 17

The Navy is doing a huge job in the great expanses of the Pacific and no small part of its success is due to the supply lines back of it. In this article is shown how much of this success is dependent upon the automotive industry. What has been done in the earlier days of the war and what is being done now is fully told.

The Failure of German Bureaucracy in France 18

For months that seemed without end the rest of the world knew little of what was happening in France and particularly in its automotive industry. Now that the skies are clearing information is coming through. This article by our correspondent there, who has been through it all from invasion and concentration to liberation tells the story from first hand information and experience.

Modern Production Facilities 24

The Mack Manufacturing Corp. has made some important improvements in its production technique. Here these innovations are fully described as well as being shown in a liberal lot of illustrations. To show just how it fits into the production line schedule there are revealing tables with the routing of parts through the different operations.

Automatic Temperature Recording Control System 32

This system for flight and test stand work has been thoroughly worked out in the Douglas plant. It has so many new features that you should make this a "must read" to keep posted on latest developments.

British Austin to Build New Model 36

New model announcements for automobiles are so rare now that even though few of these cars will be produced for some time to come it is real news on the old front, so read it.

AUTOMOTIVE INDUSTRIES

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Stimulate Enterprise—Create Jobs

By Alfred P. Sloan, Jr.

WE FACE two consequential problems; one is the attempt to maintain the peace and eliminate war, and the other is to provide the opportunity to work for those who want jobs. Neither of these objectives has ever been reached. Both problems have been growing in intensity over the years.

Too much emphasis cannot be placed on the problem of jobs. We know, in looking back over the '30's, that political-economic policies have served to freeze the economy. We had a situation during that time where enterprise couldn't expand, and expanding job opportunities could not be provided. In other words, we created a synthetic depression that followed one in fact.

Today, the cry for opportunity, for jobs for those who want to work, is international. It echoes and re-echoes around the world. It has been reflected in the utterances of the Prime Minister of Great Britain, the President of the United States, and the doughboy wherever he may be on various operating fronts. He asks, "Am I to have a job when I have done my duty?"

How do jobs come about? How do we create jobs? There is a lot of misunderstanding about that. Some people think that industry can make as many jobs as it wants. But I want to emphasize the fact that jobs are an end result. They are not a means to an end. They do not just happen. They do not result from wishful thinking. There are no rabbits in this particular hat. Political promises do not create jobs. Jobs flow from a combination of capital, management and opportunity and nothing else. Without these ingredients, there can be no jobs.

The foundation of jobs, the thing that makes them possible, that expands them and develops them, is confidence in the future of enterprise. It never will be otherwise; never was, and never can be. We should use great efforts, therefore, in developing a better understanding of what constitutes jobs in order that we may accept this tremendous challenge of the post-war era.

We cannot meet this challenge by adopting panaceas. We tried all that in the '30's. It didn't work, and never will work. We have to do those things that stimulate enterprise, that build confidence. Men cannot plan ahead unless they have confidence in the future of enterprise. They cannot move if their confidence or their faith is lacking or if they are ham-

(*Turn to page* 90, *please*)

★ Twisting a piece of wire sounds like a simple matter, but actually, in the making of better springs, it is quite a significant operation. By evaluating the results of a twist test, the Muehlhausen spring technician is able to select stock that will withstand the torsional strains to which springs are subjected in use.

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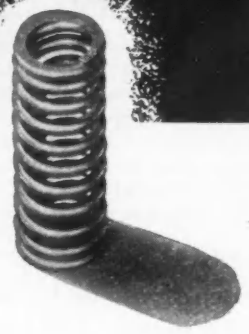

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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

December 15, 1944
Volume 91, No. 12

The Navy Looks to the Automotive Industry

By Joseph Geschelin

WHEN Admiral Nimitz addressed the American people from Pearl Harbor directly after the defeat of the Japanese navy in Philippine waters, he pointed out that "more ships are needed, for replenishing the fleet, and fuel, provisions, and ammunition as the attack get nearer and nearer the Japanese homeland."

Indeed, history will show that one of the revolutionary operations introduced by our Navy in this war is that of roaming the vast stretches of the Pacific, stalking the enemy wherever he may be, while continually getting farther and farther away from its bases. The secret of this performance is a supply line in constant contact with the fleet. As the theater of operations expands, the supply line will have to stretch. That means still more ships, more engines and machinery, and increasingly more spare parts.

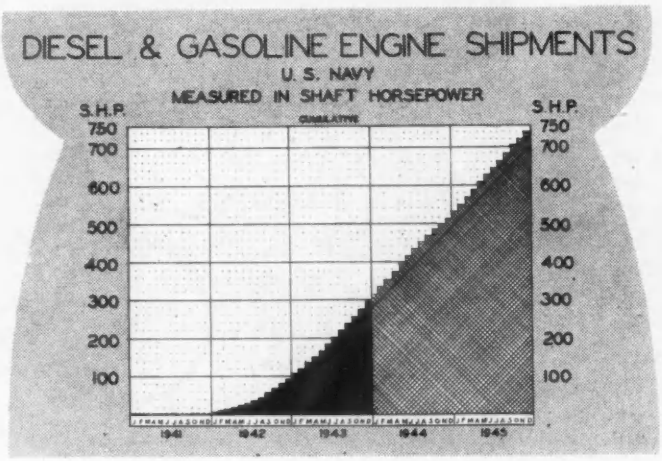
For the first time in its history, the U. S. Navy has swung decisively to the internal combustion engine for power. At the SAE Diesel Meeting in May, 1944, Captain Lisle F. Small, Bureau of Ships, announced that as of October, 1943, the combined horsepower of Diesel engines installed in Navy craft exceeded that of steam turbines. At the same time, he mentioned that funds for the 1944 amphibious program covered about 27,500,000 horsepower in Diesel engines for propulsion.

At this critical stage of the war, the Navy looks to the automotive industry for Diesel and gasoline engines and for the multiplicity of major wearing parts required for maintenance. These requirements far exceed the estimates of laymen and extend farther into the future than do other military programs. It can be said at the outset that automotive production for the Navy will continue uninterrupted after V-E Day and is being projected several years beyond that. In effect, this implies that the Navy portion of the work load will continue unabated and will constitute an important effect upon the producers of internal combustion engines and automotive parts during the adjustment period of American business following V-E Day.

PUBLICATION of this article has been authorized by the Navy Department. It emphasizes the leading role of the automotive industry in the Navy's program and highlights the job yet to be done for the war in the Pacific.

Beginning around Pearl Harbor the Bureau of Ships, U. S. Navy, sought the cooperation of the automotive industry in its then growing production problem. With the exception of a small group of marine engine builders, the engine building group of the industry had had little contact with the Navy and a good part of facilities already were producing for the Army. From the very beginning in 1942 there was no single producer of Diesel engines with sufficient capacity existing or projected to handle the entire program. This was equally true of production of gasoline engines. It ruled out the possibility of standardizing on a minimum of engine makes and models.

(*Turn to p. 78, please*)



The Failure of German in France and the

UNDER German occupation every automobile factory in France was obliged to operate for the benefit of the Reich. The industry was severely controlled through the COA (Comité de l'Organization de l'Automobile). A German official was made responsible for every factory, the supply of raw material was regulated by German offices, and labor disputes were made impossible by abolishing all unions and imposing a government-controlled organization in which membership was obligatory. Any attempt to avoid the German obligations was followed by the seizure of the plant and the possible deportation or imprisonment of the management. So great were the penalties that there was practically no open rebellion. Some company officials and engineers were imprisoned for not carrying out German orders, and hundreds of workers were deported for acts of insubordination.

Speaking broadly, therefore, the entire French automotive industry contributed towards the strength of the German war machine. Now that it is over, patriots can raise an accusing finger against every leader of the industry, while the more advanced socialist and communist element is taking advantage of the present situation to attack industrialists almost indiscriminately. We have the impression that there is a lot more political passion than patriotism behind these attacks. Pushed to its logical conclusion, every worker is equally guilty with every owner. The men had to work or starve. The owners had to operate their factories or lose their positions and all they possessed. Imprisonment or poverty was the fate of owners and workers alike.

It is claimed that certain manufacturers placed themselves voluntarily at the service of the Germans and increased production by all possible means. On the other hand, large numbers of industrialists held back production in various ingenious ways, closed their eyes to sabotage, organized espionage in favor of the Allies and facilitated the escape of workmen who were called up for forced labor in Germany. It is to be hoped that the courts will be sufficiently powerful and impartial to judge each case solely on its merits and to remove any attempt at political vengeance.

After liberation of France, a campaign was started

NEUTRAL correspondents in late 1939 and in 1940, it will be recalled, sent news reports to their homelands telling how the Germans, with their characteristic thoroughness and efficiency, established economic controls over conquered European peoples. Soon after, while the military conflict spread, there began another war, perhaps as intense and not less spectacular though veiled, of the resistance of these conquered people against German bureaucrats. Resistance was intensified because it was their enemy who sought to dominate their lives.

In this article W. F. Bradley, for 30 years the European correspondent of AUTOMOTIVE AND AVIATION INDUSTRIES, vividly describes one phase of the struggle in France—how the automobile business collapsed there. During the German occupation of France Mr. Bradley was held in a concentration camp for two years and then was released, after which he was under close observation for the next two years until the liberation of France by the United Nations' Armies.

Bureaucracy Subsequent Chaos

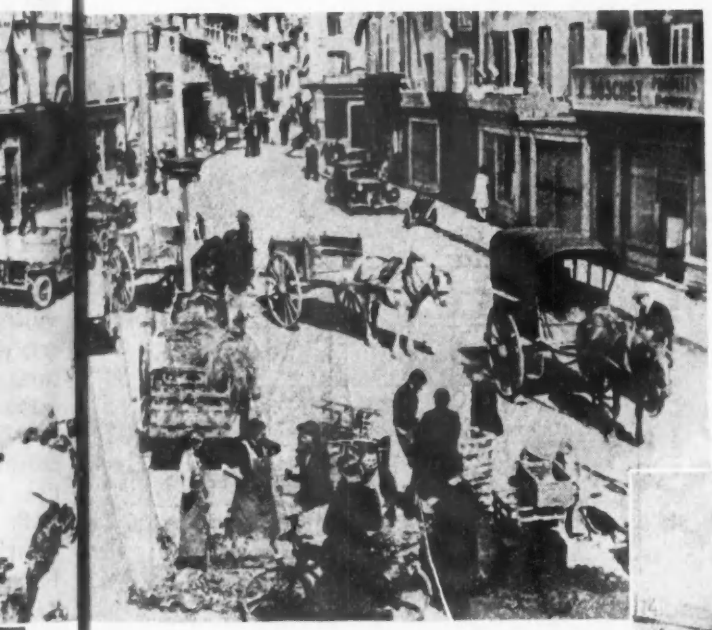
By W. F. Bradley
European Correspondent,
AUTOMOTIVE and AVIATION INDUSTRIES

against the "trusts," and under this title are included such firms as Renault, Berliet and Citroen. It is difficult to conceive a trust in the French automotive industry where three highly competitive firms are responsible for 80 per cent of the production, and where three equally competitive firms control most of the tire production.

Finally the provisional government of France has decreed the confiscation of the Renault Co., the biggest automobile factory in France and perhaps in Europe. The announcement occupies 15 words in the communiqué covering the meeting of French ministers, and this is really all that is known about one of the most significant moves of modern times. Inquiries among Renault officials brought forth no more information. It was pointed out that the decree has not yet appeared in the *Journal Officiel*, and until this comes out it would be futile to speculate. The use of the word "confiscation," however, appears to indicate that the State will take possession of the Renault factory without any compensation being given to the owners. Practically all the holdings are in the hands of members of the Renault family. Louis Renault, its founder, died recently while awaiting trial on a charge of trading with the enemy. The value of the Renault plant at Billancourt, near Paris, has not been determined, but some idea can be obtained from the fact that the damage from aerial bombardments amounted to $30,000,000. It is estimated that about a quarter of the factory is at present destroyed.

With Renault as a State organization, will it be possible to compete, even on the home market, with the two other big manufacturers, Citroen and Peugeot? Members of the industry appear to be of the opinion that the necessary spirit of initiative and enterprise cannot be maintained in a State organization and that Renault will cease to exist as a factor on the market. If the works are made use of for the production of trucks for State and municipal organizations, these will not be sufficient to allow the company to maintain its present position on the home and foreign markets. Others maintain that enterprise is not necessarily limited to private industry. The fact remains, however, that the nationalization of the aeronautical industry, in 1936, resulted in an immediate and rapid drop in production and left the French air force in a very critical condition when war was declared.

(*Turn to page* 102, *please*)



Typical Transportation Scenes in War-Torn France

(Above) Horse-drawn carts predominate in this market scene at Cherbourg (Acme photo).

(Left) In the outskirts of Paris normal transportation facilities for civilians are lacking and travelers must wheel or walk. This licensed trailer towed by a bicycle is one mode of transportation (Associated Press photo).

(Right) At Liege, due to a shortage of motor transportation, this trolley car was pressed into service to deliver fruit about the city (International News photo).

Fuel Injection for

DEVELOPMENT work on fuel-injection systems for aircraft engines was started at Curtiss-Wright as far back as 1930, and a sort of chronology of projects undertaken along this line is given at the end of this article. From results obtained up to 1938 the following conclusions were drawn:

1. Injection into the cylinder is preferable to manifold injection, because with the former both low- and high-volatility fuels can be used, and the volumetric efficiency is higher.

2. The simple poppet-valve-type of spray nozzle shown in Fig. 1 is the most practical of all those tested, and the optimum discharge pressure is between 400 and 500 psi. The spray angle of the nozzle has an important influence on the results, and it was decided to use a 30-deg spiral spray.

3. With fuel of high volatility, the position of the nozzle in the cylinder head is not very critical. On the other hand, with fuel of low volatility it was found necessary to direct the spray toward the center of the combustion chamber, to avoid excessive oil dilution.

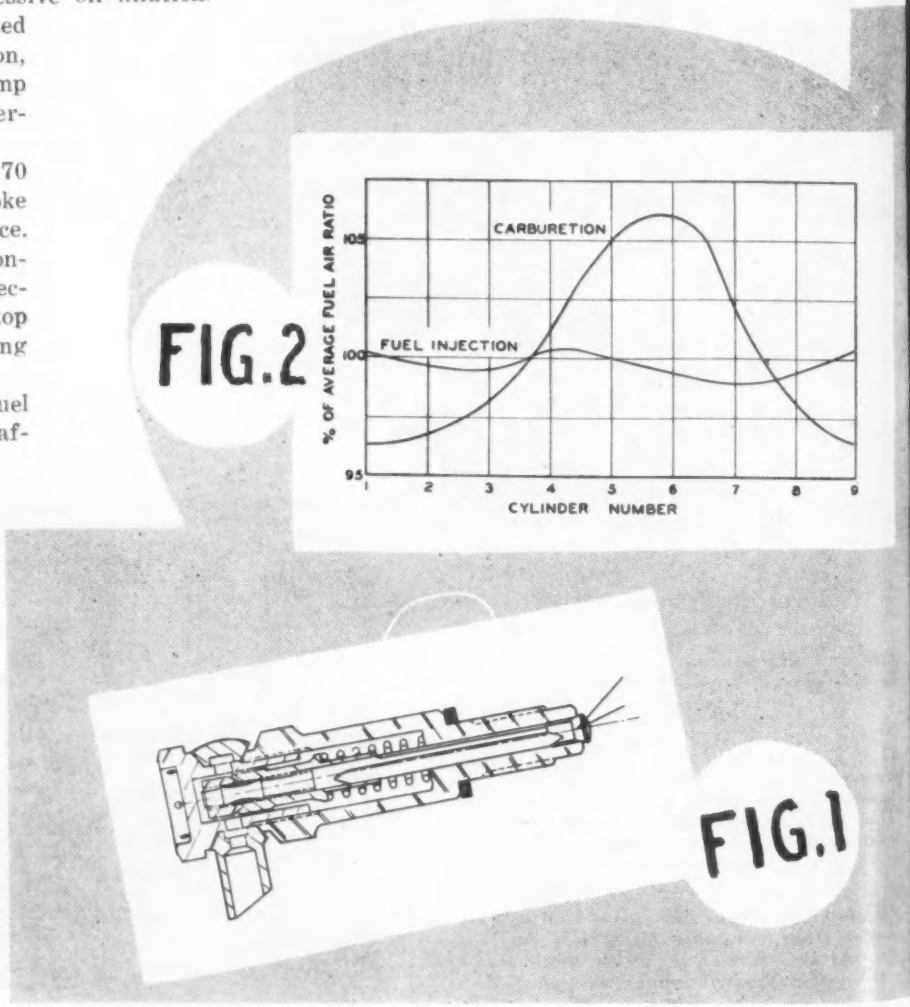
4. With the particular engine used in the tests, the duration of injection, within practical limits set by pump design, has no effect on engine performance.

5. Injection ending 60 deg to 70 deg ATC on the engine intake stroke gives optimum engine performance. However, when injection lag is considered, this setting results in injection beginning at approximately top dead center, under other than idling conditions.

6. Variations in the length of fuel lines between 3 and 10 ft do not affect engine performance appreciably.

Fig. 2 shows plots of typical mixture-distribution data for fuel-injection and carburetor engines respectively, under rated load at sea level and 60 F—100 F intake temperature. With fuel injection there is a spread of 6-7 per cent of the average in the mixture ratio of the individual cylinders, while with the carburetor engine it varies from 11 to 17 per cent, depending on the throttle angle. The effect of throttle angle on mixture distribution is rather indeterminate, but the curve corresponds to the results generally obtained. With the carburetor engine, altitude and extremely cold air further increase the spread, and render an explanation of mixture-distribution phenomena more difficult.

Fig. 2 shows that fuel injection furnishes the long-sought solution to the problem of uniform distribution in radial engines. Distribution curves have been obtained at different powers, mixture ratios and throttle openings, and at intake temperatures down



This article has been adapted from the Wiegand-Meador paper of the same title presented at the 1944 National Aeronautic Meeting of the Society of Automotive Engineers held in Los Angeles, Cal.

Fig. 1—Injection nozzle found to be most practical for cylinder-head injection.

Fig. 2—Mixture distribution curves of fuel-injection and carburetor engines (Wright Cyclone C9G) at full throttle.

By F. J. Wiegand and D. W. Meador
Wright Aeronautical Corp.

Aircraft Engines

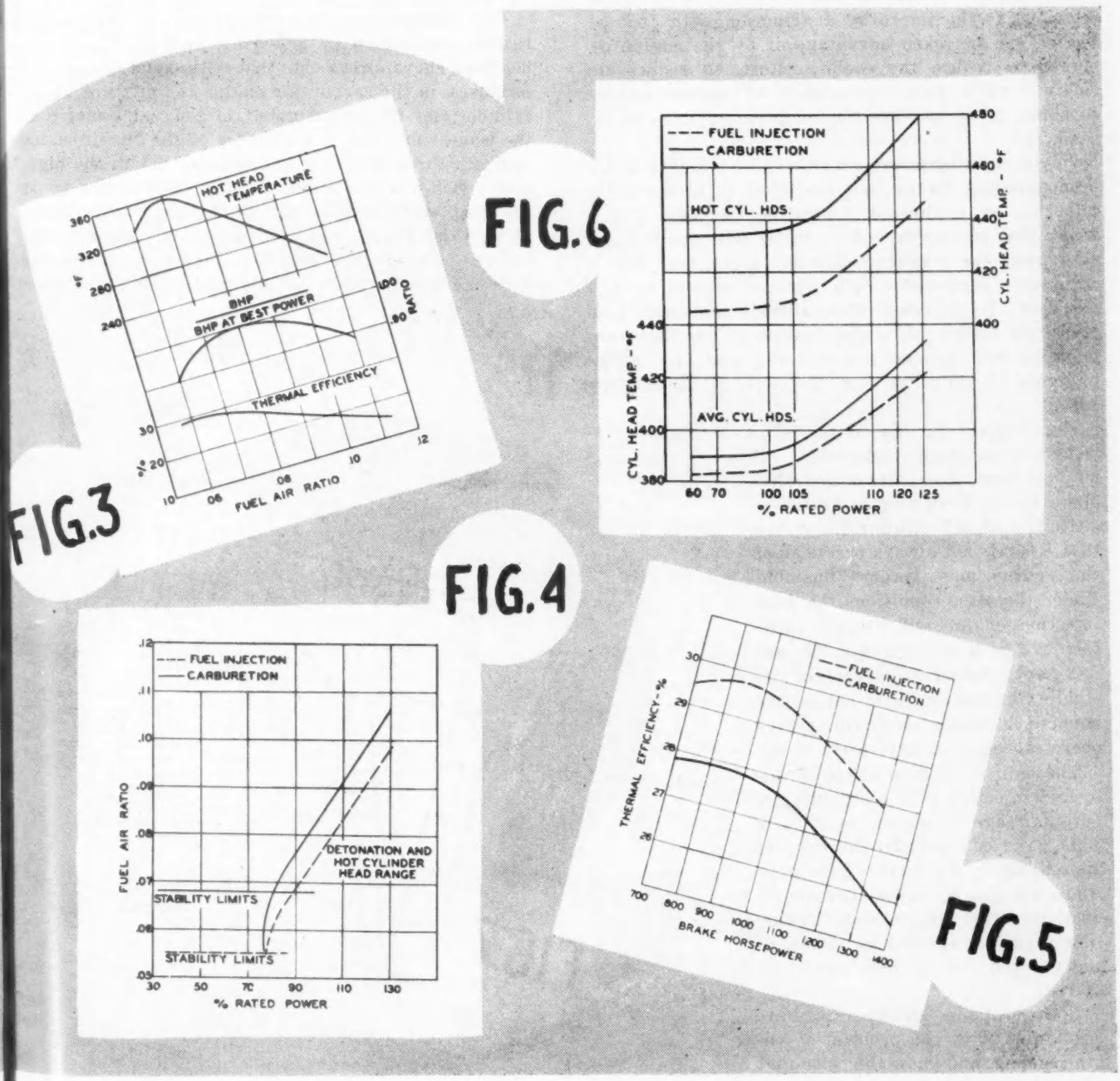
to minus 50 F, and in each case the distribution was as good as, or better than, that represented by the curve in Fig. 2. Carburetor engines require heating of the intake air long before the temperature drops to minus 50 F, and distribution undoubtedly becomes less uniform as the temperature drops, until finally the engine becomes unstable. With fuel injection the inlet-air temperature has no effect on the distribution, as fuel is metered accurately to each cylinder. Air heaters are not required, and the lower tem-

Fig. 3—Curves of hot-head temperature, max. bhp and thermal efficiency vs. fuel/air ratio.

Fig. 4—Allowable operating ranges with fuel injection and carburetion.

Fig. 5—Curves of thermal efficiency vs. output with "automatic cruising" lean F/A mixtures (140 bmep, 20 deg spark advance).

Fig. 6—Cylinder-head temperatures with fuel injection and carburetion (test stand data).



perature of the induction air results in a higher volumetric efficiency.

An idea of the effect of mixture distribution on engine performance may be obtained from Fig. 2. There it is shown that the leanest mixture in a cylinder of the carburetor engine is 11 per cent leaner than the leanest in a cylinder of the fuel-injection engine. If the mixture ratio in this cylinder of the carburetor engine is the leanest permissible for any cylinder at rated power and satisfactory cooling, then the mixture ratio of the leanest cylinder in the fuel-injection engine can be made the same. In that case the mixture for the whole engine will be 11 per cent leaner with the fuel-injection than with the carburetor engine, for a given maximum cylinder-head temperature. A further advantage resulting from the better fuel distribution with injection equipment is that, as shown in Fig. 3, in the high-power range a decrease of 11 per cent in the fuel/air ratio results in a 3 per cent increase in thermal efficiency. It is thus apparent that the improved distribution with fuel injection can be taken advantage of by the engine designer to reduce the cooling effort, to reduce the fuel/air ratio with the object of increasing the economy, or to increase the compression ratio to the same end.

In the cruising-power range, engine stability is the predominating factor, and the effect of mixture distribution on it therefore must be studied. Fig. 3 shows that the power output varies with the mixture ratio near the maximum-economy point, and with a carburetor engine the variation can amount to ± 7 per cent; it increases with altitude and with progressively deteriorating distribution. Thus the power impulses will become non-uniform, and the engine will tend to "hunt" around the hook of the mixture curve.

Fig. 4 gives an idea of the effect of mixture distribution on engine operation. It may be seen from this graph that operation of a carburetor engine at altitude with a fuel/air ratio of less than 0.069 is not always practical, as the engine may become unstable. Under the same conditions the fuel-injection engine will operate satisfactorily on a mixture of 0.055, and even with leaner mixtures the instability of the engine is not as pronounced as with a carburetor engine operating on a mixture below 0.069.

The gain in thermal efficiency due to fuel injection over a considerable output range is shown in Fig. 5. This gain is generally taken to be approximately 6 per cent. This alone would account for a considerable reduction in fuel consumption. A further saving is effected by reason of the reduced cooling horsepower required.

Both designers and operators are acquainted with the problem of engine cooling, and know the price that must be paid to reduce the temperature of the hottest engine cylinder by 10 F or 20 F. An analysis of the effect of fuel injection directly into the cylinder on cooling has been made, and it was shown that the temperature of individual cylinders were lowered a few degrees. Much greater improvements result from the better distribution and leaner mixtures in the cruising range. Engine test data plotted in Fig. 6 show a reduction of 6 F to 12 F in the average cylinder-head temperature, and 30 F to 35 F in the temperature of the hottest cylinder. This reduction on the temperature of the hottest cylinder head permits a reduction in the opening of the cowl flap, with a resultant reduction in the horsepower requirement for a constant air speed, and a reduction in the fuel consumption. This fuel saving is additional to that due to the higher thermal efficiency discussed previously. Flight-test data plotted in Fig. 7 show that the improvement in cylinder-head cooling is confirmed in service.

The improvement in cylinder-head cooling can be readily understood by referring back to Fig. 3. It has been shown previously that with equal overall fuel mixtures, in the carburetor engine the mixture in one cylinder may be approximately 11 per cent leaner than the leanest mixture in a cylinder of the fuel-injection engine. From Fig. 3 it will be seen that in the high-power rich-mixture range, leaning the mixture by 11 per cent will increase the head temperature about 25 F, which agrees well with test data. In carburetor engines distribution becomes progressively poorer with increase in altitude, and cooling conditions be-

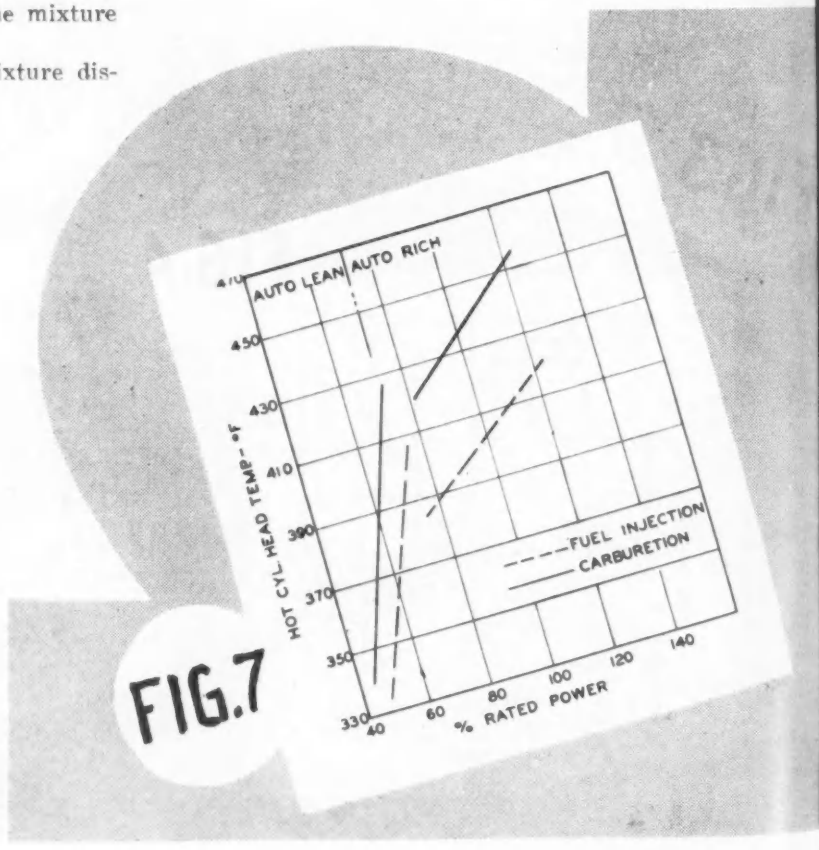


FIG.7

come more difficult as a result. In the cruising-power range the chief reason for the drop in the average temperature is the lower fuel/air ratio possible with fuel injection. Fig. 3 shows that the average cylinder-head temperature drops approximately 18 F when the fuel/air ratio is changed from the carburetor autolean value of 0.070 to the fuel-injection setting of 0.062. This also agrees well with test data.

A curve of fuel-injection hp/carburetor hp under full throttle and with optimum supercharger equipment is shown in Fig. 8, and indicates a slight advantage of the injection engine at high speeds. The higher intake-pipe temperature of the fuel-injection engine reduces the full-throttle manifold pressure about 1 per cent, as shown, but this loss is over-balanced by the gain due to the higher volumetric efficiency of the fuel-injection engine for the same manifold pressure, with the result that the output of the fuel-injection engine is from 2 to 4 per cent higher.

In a non-supercharged engine the power output is increased if the carburetor restriction and the air heater are removed. In a highly supercharged engine, however, it is advantageous to vaporize the fuel ahead of the

(*Turn to page 94, please*)

Fig. 7—Cylinder-head temperatures in flight.

Fig. 8—Comparison of engine performances with fuel injection and carburetion.

Fig. 9—Comparison of supercharger performances with fuel injection and carburetion (2400 rpm).

Fig. 10—Comparison of typical altitude performances with fuel injection and carburetion.

FIG. 8

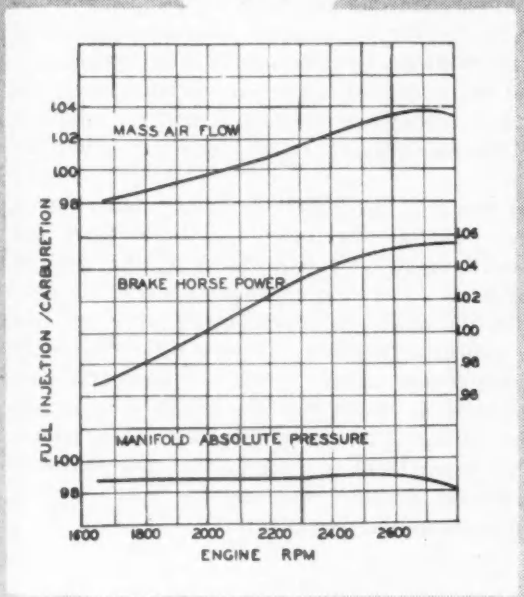


FIG. 10

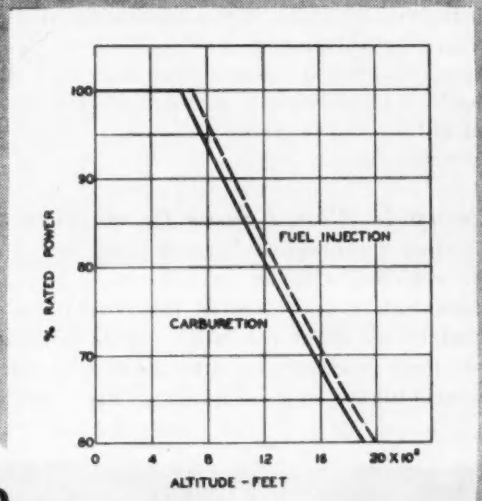
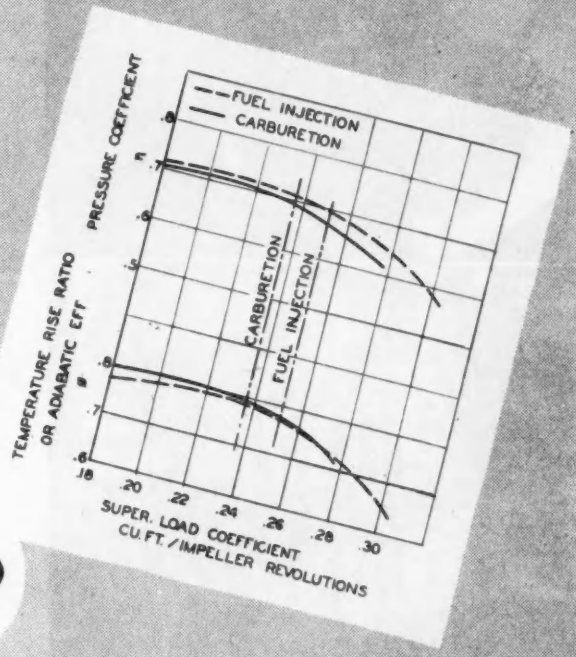


FIG. 9



Modern Production

IMPORTANT improvements in manufacturing facilities with their consequent refinement in production methods have been effected in the three major plants of the Mack Manufacturing Corp. The wartime activity of the assembly plant in Allentown, with its extensive machine shops for the production of axles and miscellaneous parts, was described in AUTOMOTIVE AND AVIATION INDUSTRIES of Jan. 15, 1944. The present article is divided into two parts, the first of which touches on some of the highlights of the engine building establishment in Plainfield, N. J. The second part is devoted to the manufacturing facilities at the New Brunswick, N. J., plant where transmissions and differential carriers are built for the Allentown assembly plant.

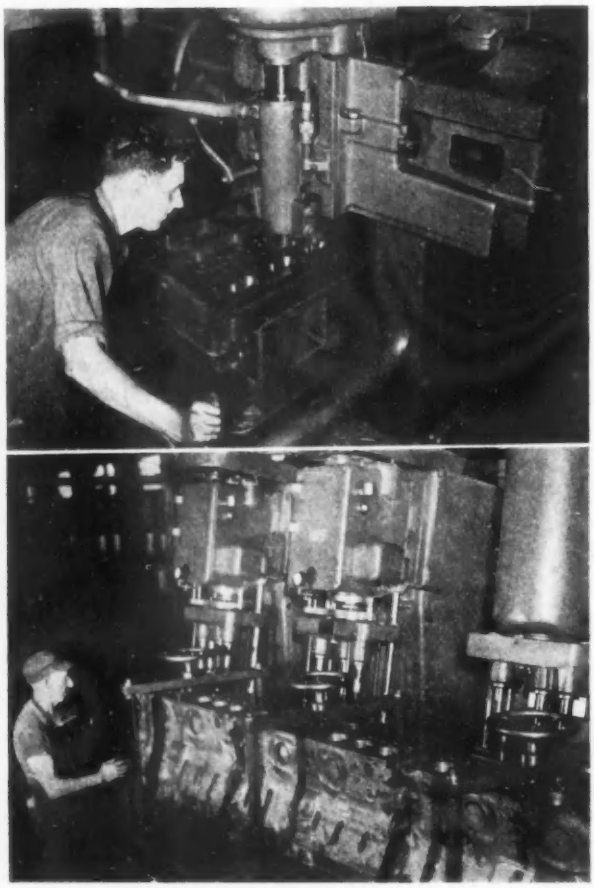
Plainfield Plant Engine Production

LONG noted as a producer of outstanding heavy duty motor vehicles, with an enviable record of reliability, Mack has in operation at this writing a completely modernized plant for large engine production, capable of high productivity, and possessing the elements for still higher levels of quality. Fleet operators will profit in the postwar period from the facilities thus created in the interest of the Army's heavy duty vehicle program.

Engine building facilities consist of two parallel lines of equipment, one for the smaller engines, six cylinder, 3⅝ in. bore by 5 in. stroke and 3⅞ in. bore by 5 in. stroke which has remained unchanged save for the introduction of some items of new equipment; the other, almost entirely new, for the three Mack Lanova Diesels and the five overhead-valve gasoline engines. The Diesels are all six cylinder, four-stroke engines, the sizes being 4¼ in. bore by 5⅜ in. stroke, 4⅜ in. bore by 5¾ in. stroke and 4⅝ in. bore by 6 in. stroke. The gasoline engines are 4⅛ in. by 5⅜ in., 4 5/16 in. by 5⅜ in., 4 7/16 in. by 5½ in., 4¾ in. by 5¾ in. and 5 in. by 6 in. In most respects the large engines are practically interchangeable from a production standpoint, thus making it possible to run the major elements such as blocks, crankshafts, and camshafts over the same machine lines and using the same fixtures. Such coordination of engineering design and production management made it possible to take full advantage of mass production techniques.

The plant has been well departmentalized with self-contained lines for the cylinder blocks, crankshafts, camshafts, connecting rods, cylinder heads, gear department, miscellaneous machine shops, heat treatment, and the testing department. Materials handling has been coordinated to eliminate manual handling—by the use of industrial trucks of various types, the installation of craneways and hoists, and the adoption of the Mathews gravity roller conveyor wherever feasible.

Consider some of the highspots of the departments noted above. Let us take first the cylinder block line which is outlined in condensed form on the routing reproduced here. The routing shows clearly the general distribution of detail operations, beginning with the initial milling of major surfaces and bearing locks on massive Ingersoll millers fitted with cemented-carbide-tipped cutters. Each machine rough- and finish-mills in one setting. Among the major items of equipment in this department is a battery of new two-way Natco horizontal drilling and tapping machines so familiar in mass-production plants.



(Top) Mack-Lanova chambers in large Diesel engine cylinder heads are produced by profiling on Pratt & Whitney profilers such as this one at Plainfield.

(Left) Unique three-head drilling machine developed by LeMaire for handling various detail operations on the large engine blocks. Blocks are moved from one fixture to another as shown in the Plainfield plant.

By Joseph Geschelin

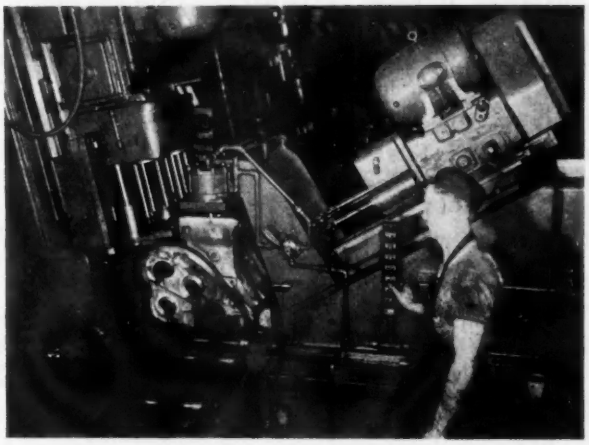
Facilities

at Plainfield and New Brunswick Plants for Mack Trucks

Here will be found an interesting LeMaire machine with three separate hydraulic units mounted on a common base, the heads being inclined to handle the rough-drilling, spot-facing, semi-finish and finish-reaming of four accessory bores. The block is moved progressively from one station to another, guided by a commonrail fixture assuring precise alignment. This coordination of operations eliminates the usual handling from one machine to another, saves time and labor, greatly increases productivity.

In the same area is a group of special Rehnberg-Jacobson sensitive drilling and tapping machines for the multiple-drilling and tapping of fastening holes for the various angularly-located accessory pads.

A variety of detail operations is handled on versatile Carlton radial drills, such operations including the chamfering of piston bores and bore clearance on the center main bearing boss. The blocks are thoroughly washed under pressure at various stages of machining and water tested prior to the installation of dry liners. Following water test, the crank line, cam line, and idler shaft bores are line-bored to dimensions



Special angular drilling machine built by Rehnberg-Jacobson. A companion unit taps the holes. (Plainfield)

Mack Plainfield Plant—Crankshaft Routing

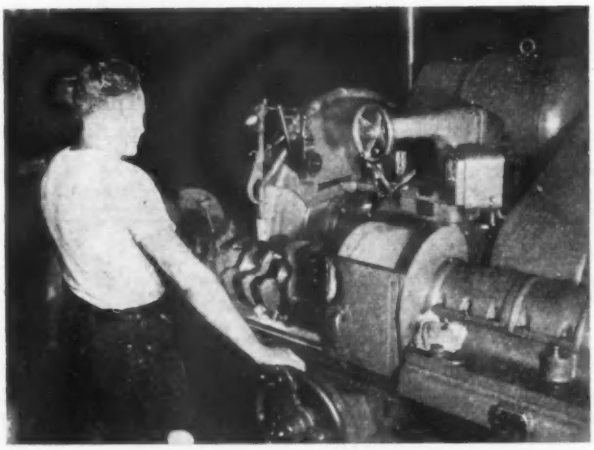
OPERATION	EQUIPMENT
Turn #3 bearing and face bearing walls	American lathe
Face #1, 4, 7 bearing walls, turn #1, 4, 7 bearings, rough face both sides of flange, face #1 bearing & face stem end and face #2, 3, 5, 6 bearing walls & turn #2, 3, 5, 6 bearings	Wickes lathe
Straighten bearings to within 0.010 run out	Hydraulic press
Face pin webs & turn 6 pins	Wickes lathe
Drill (3) holes through 3 pins & drill (3) 1½ holes through 3 pins & turn counterweights	Natco multiple drill Pond lathe
Rough turn & face flange end & form radius & rough turn stem end	LeBlond lathe American lathe
Mill driving slot in flange	24 in. Cincinnati automatic mill
Drill oil holes	Avey sensitive drill
Straighten after drilling oil holes	Hydraulic press
Face & re-center both ends, turn stem end to 2.020-2.025, undercut	American lathe
Countersink oil holes, grind all sharp edges from all around webs and grind lightening holes	Bench
Rough grind main bearing, allow 0.005 in. on each face for finish	Landis grinder
Rough grind pins	Norton grinder
Grind intersection & radii on oil holes	Bench
Assemble wooden plugs & fiber discs, Tocco harden and draw	Tocco electric furnace McCann gas furunace
Inspect hardness Scleroscope 80-85	
Straighten	General flexible power press
Re-center both ends	
Finish grind main bearings, stem & flange	LeBlond lathe
Finish grind pins	Norton grinder
Multi drill (6) 29/32 in. holes, through flange & cut 2 keyways	Norton grinder Baker drill
Mill flywheel bolt seats, countersink 6 flywheel bolt holes and grind burr from edge of web at center main bearing	Cincinnati automatic mill Cincinnati automatic mill
Final straighten bearings within 0.001 in.	Acme screw machine Hannifin air press
Finish form 15 deg. angle & finish face flange	Lodge & Shipley lathe
Ream 6 flange holes, grind all oil holes, clean & blow chips & polish bearings and pins	Bench
Balance	Tinius-Olsen balancing machine
Magnaflux	Radial drill
Grind out cracks on oil holes in pins, bearings & throws where necessary	Bench
Inspect	
Lap 7 bearings and 6 pins	Schraner lapping machine
Clean and oil crankshaft	

in a horizontal W. F. & John Barnes boring machine.

Particular attention is devoted to the finish of cylinder bores. The bores are first honed on a Moline honing machine, preceding installation of liners. Liners are then pressed-in on a Logan hydraulic press and are honed on another Moline machine. Based upon close study of field experience as to bore and ring life, Mack has established a standard surface finish of 20-30 micro-inches (rms) as being the best type of finish for heavy duty operation. Midwest abrasive sticks are used in the hones to produce this character of finish. The combination of control of cylinder boring and honing operations produces excellent bores within a tolerance of 0.0005 in. for taper and out-of-roundness.

Finishing of the cylinder gasket surface to assure alignment of the tops of the sleeves with the head surface is another important detail. This is done by surface grinding on a large Mattison grinder.

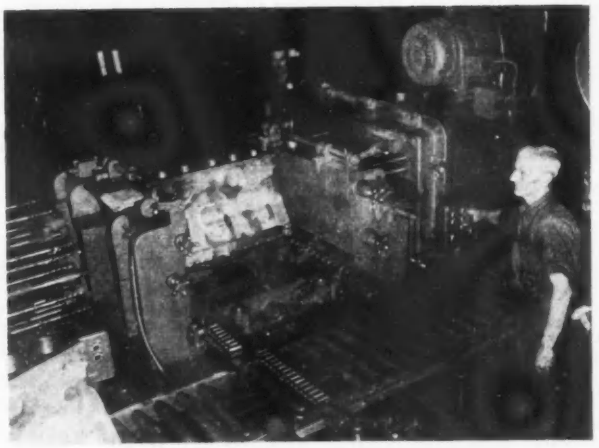
The next element selected for special study is the crankshaft. From the routing reproduced here it will be noted that the major turning operations on the journals and pins, and cheeking, is done on a battery of Wickes crankshaft lathes. The crankshaft department has two parallel lines—one for the large shafts;



New Norton crank grinder handles the finish-grinding of crankshaft pins at the Plainfield plant.

the other for a number of small shafts. Between the lines is a heavy rail system on which the shafts are suspended for feeding the individual machines. Noteworthy feature of this setup is the application of a ceiling-mounted Curtis air cylinder at each machine to facilitate the handling of the heavy shafts in and out of the machines. The routing indicates the location of straightening operations following a pre-determined series of metal removal stages. Oil holes are drilled in a new Avey sensitive drilling machine.

Mack is particularly proud of their insistence upon crankshaft quality and serviceability. Using Landis, Cincinnati, and Norton grinders, fitted with a special type of steady rest, they produce pins and journals free from taper and out-of-roundness. To assure maximum life of cranks, the pins and journals are selectively Tocco-hardened. And in order to retain



One of a battery of new Natco two-way multiple-spindle drilling and tapping machines on the large block line. This one takes the drilling in the ends of the block. (Plainfield)

the maximum surface hardness, these sections are rough-ground within close finish for finish-grinding prior to Tocco hardening. The routing shows the rough-grinding of journals on a Landis grinder, and rough grinding of pins on a Norton before hardening.

After rough-grinding the shafts are hardened in a special six-station Tocco machine built to Mack specifications, then drawn in a McCann gas-fired furnace. The shaft is straightened, re-centered on a LeBlond lathe, finish-ground in separate settings on Norton crank grinders. This is followed by detail drilling operations, milling on Cincinnati automatic mills, straightening, finish-forming of the flange on a Lodge & Shipley lathe, balancing on a Tinius-Olsen machine, and Magnaflux inspection. Final operation is the lapping of main bearing journals and pins on a Schraner lapper which is adjusted to produce a surface finish of 10 micro-inches.

In view of the mention of surface finishes, it is interesting to find that the plant has a master standard in the form of the Brush Surface Analyzer for the establishment of surface finishes for a variety of parts. Each department is provided with standard blocks which give a visual guide to the character of surface finish required.

Connecting rods are handled in a self-contained department, starting as a one-piece forging, the cap being sawed off in a Cincinnati milling machine. First major operation on connecting rods is the formation of the bore and of the tongue-and-groove slots in the parting line. This is done in one setting in a Cincinnati Duplex Vertical Hydro-Broach fitted with special broaching tools for the purpose. The rod is handled in one of the two fixtures, the cap in the other fixture.

Both skill and ingenuity have been exercised in the development of methods for machining connecting rods. A basic feature is the establishment of three centers in the forging—one on the boss at the small end, the other two at the big end. These centers are employed for the holding of rods on all operations, thus assuring precise alignment without the use of complicated fixtures.

Heald Bore-Matics, fitted with cemented-carbide fly-cutters, are used for the semi-finish and finish-boring of both ends of the rod. This is done in separate settings in different machines, taking both ends of the rod at one time.

As a check for quality all rods are Magnaflux-inspected for surface perfection. The Sheffield Precisionnair gage is used for checking bores, the diameter of the big end being held to 0.00025 in. clearance. All rods are balanced end-for-end for weight and then selected in matched sets for weight.

Mack makes its own camshafts in another self-contained department. These are machined from forgings, case-carburized selectively to produce the desired surface hardness. One of the major features of camshaft production is the use of Landis cam grinders equipped with full automatic controls. The infeed rate is variable and automatically controlled so as to produce a standard cutting speed on all surfaces of the cam. This arrangement has a vital bearing on the life of the shaft as it has eliminated the drawing of surface hardness at the nose of the cam. All camshafts are Parker-Lubrized after machining.

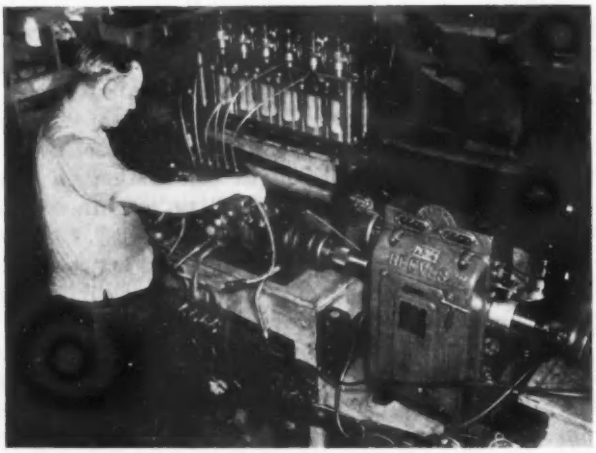
Cylinder heads, too, are machined in a separate department. An important detail of the Diesel head is the development of the Lanova combustion chamber cavity on Pratt & Whitney profiling machines fitted with an automatic tracer arm attachment. Cylinder heads are milled on large Cincinnati Vertical mills. This department is provided with Blakeslee Niagara washing machines for cleaning the work.

In addition to the major machine lines touched upon in the foregoing, the plant boasts a large general machine shop for miscellaneous parts of various kinds and a large heat treating department for handling camshafts, gears, piston pins, and other parts.

The gear department, producing the timing gear train, is another noteworthy operation. On Mack engines the timing gear train consists of all-steel ground gears selected in matched sets. After processing, the

Mack Plainfield Plant—Diesel Cylinder Block Routing

OPERATION	EQUIPMENT
Mill top, bottom & bearing lock surfaces & mill 10 deg. angle pad	Ingersoll miller
Multiple drill (26) 5/16 in. & (2) ⅝ in. holes in pan surface. Hand ream (2) ⅝ in. holes.	Natco multiple drills Electric drill
Multiple drill 18 bearing stud holes, countersink all multiple drilled holes, rough & semi-finish bore 6 piston holes	6-spindle Moline boring machine
Mill ends & backface of pads & mill both sides	Ingersoll millers
Finish bore piston holes	2-spindle Moline boring machine
Multiple drill 40 cylinder head stud holes, multiple drill water holes & countersink stud holes & drill 2 long "R" oil holes	Bausch multiple drill Natco multiple drill Electric drill
Mill fuel pump pad, drill main oil line, straddle mill main bearing bosses & multiple tap 26 pan holes & 18 bearing stud holes	2-spindle Avey drill Cincinnati miller Ingersoll miller 2-spindle Barnes drill
Fit and assemble bearing caps	Natco multiple tapping machine Conveyor
Rough bore crank, cam, idler & pump holes. Semi-finish bore crank, cam, idler & pump holes & face cam & idler bosses	Natco boring machine
Cut oil grooves and bearing locks	Universal boring machine
Cut bearing lock grooves in caps and face oil pump pad	Hand miller Universal boring machine
Bore & face oil pump hole & bore compressor guide ring hole	W. F. & John Barnes boring mill
Multiple drill holes in ends, countersink multiple drilled holes & multiple tap both ends	Natco multiple drill Natco multiple tapping machine Electric drill
Multiple drill, countersink & tap holes in both sides	Natco multiple drill Natco multiple tapping machine Electric drill
Drill, semi-finish ream & spot-face hole. Multiple drill 10 deg., 14 deg., and 30 deg. angle holes, countersink & tap angle holes	LeMaire 3-head drill Rehnberg-Jacobson multiple drill & multiple tapping machine Electric drill
Multiple tap (40) cylinder head stud holes, multiple drill 14 "R" angle holes (oil) & multiple drill 12 valve guide holes, counterbore & countersink valve guide holes	Natco multiple tapping machine LeMaire multiple drill Natco multiple drill Electric drill
Drill & tap oil pump pad holes, oil gage holes & angle oil holes	American radial drill
Chamfer piston bores, bore clearance on center bearing boss and drill "R" oil holes	Carlton radial drill
Drill, tap, plug & face both ends and (1) side of cylinder block	Carlton radial drill
Drill, tap, plug & face valve cover side	Carlton radial drill
Drill, tap & face pipe hole, surface (1) 7/16 dia., drill, tap and surface 5/18 in. hole, tap ⅜ in. pipe hole, drill "R" oil hole, drill 20 holes, and chamfer piston bores	Carlton radial drill
Grind clearance	Bench grinder
Wash, blow out all holes & recesses (first wash) & wash caps	Industrial washer
Water test, cut oil grooves and reassemble bearing caps	Water test fixture Motor driven fixture & conveyor
Finish bore crank, cam & idler shaft holes & countersink valve guide holes	W. F. & John Barnes boring machine
Inspect	
Rear & bearize valve guide holes & finish mill rear end	American radial drill DeVlieg miller
Hone piston bores for sleeves	Moline honing machine
Wash, blow out all holes & recesses (2nd wash)	Industrial washer
Face center main bearing to width	Mack boring machine
Counterbore for sleeves	1-spindle Footburt boring machine
Press in sleeves	Logan hydraulic press
Hone sleeves	Moline honing machine
Surface grind top	Mattison surface grinder
Wash, blow out all holes & recesses (third & final wash)	Industrial washer
Chip, file & hand ream where necessary	Platform
Final inspection	



Unusual feature in the engine assembly section is the special flow bench, Mack-designed, for the testing of fuel injection pumps and nozzles. (Plainfield)

gears are first selected in matched sets by mating in a match plate so as to produce the proper correspondence of centers for the mounting. Then the matched sets are installed in dummy engines in a "quiet" room where they are tested for running at critical engine speeds. If noise develops on this test, gears are re-matched until the proper degree of quietness has been achieved. The gears are then marked in sets for installation on the engine assembly line. This procedure will explain why Mack supplies matched sets only, for infrequent service demands.

View in the new foundry shows a pouring station on one of the several mechanized pouring conveyor lines at the New Brunswick plant.

Gears for the timing sets start in the form of forged blanks which are machined, hobbed, heat treated, then ground on Pratt & Whitney precision gear grinders. Mack has a large battery of P & W machines of two-wheel and single-wheel type in this department. Gear bores are finish-ground on Bryant internal grinders.

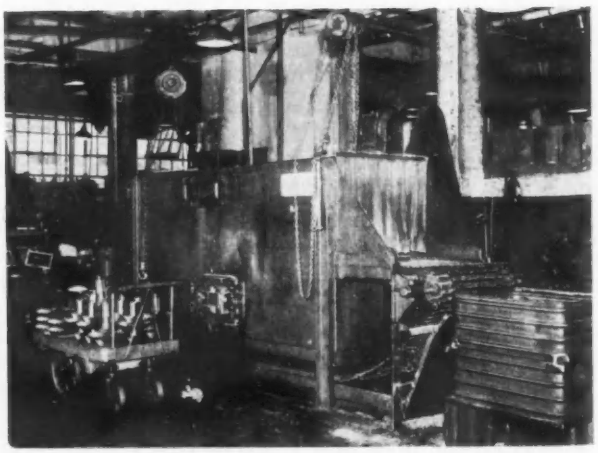
Mack produces its own rocker arms and rocker arm connections. Heald Bore-Matics are employed for the finish-boring of rocker arm bushings. In this connection an interesting piece of new equipment is a Tocco, Jr. hardening machine used for the hardening of push-rod ends and sockets, thus eliminating the former method of case-carburizing.

Speaking of quality control, there is emphasis given to cleanliness particularly in the case of cylinder blocks. Various types of washing machines are used to assure the complete removal of dirt and chips and sand. An unusual feature of quality control is found in the small receiving inspection department where outside purchased parts such as carburetors, fuel injection pumps, governors, etc., not only are inspected but are gone over by trained mechanics to assure completeness of detail, the addition of missing fastenings, adjustments, etc. In some instances this department literally takes apart and re-assembles such units before they are passed on to the assembly department.

Among other things this department inspects all engine bearings. And for this purpose they use a special "crush" test device developed by Mack engineers as a criterion of bearing shell conformity to size. This machine uses a standard dead weight applied by gravity to eliminate the human element in the interest of interchangeability.

Although engine assembly is handled along conventional lines, a distinguishing feature is the use of Mack-designed flow benches for testing Diesel fuel pumps and nozzles under standard conditions before the matched sets of nozzles and fuel pumps are issued to the assembly floor. The flow benches calibrate the pumps and nozzles; also make the fuel pump governor adjustment. This method of calibration, handled so simply with the special flow bench equipment, has eliminated the need for adjustments on the dynamometer test, and has resulted in a rapid and simplified procedure in the testing department.

Mack engines are given a final dynamometer test of about 4½ hours. Each engine then is torn down at the pan end for thorough inspection. Spare engines, which will not have the benefit of a road test in the vehicle, are given a rerun of three hours on the



Here is one of a number of Blakeslee Niagara parts washing machines in various parts of the New Brunswick plant.

dynamometer after tear-down inspection.

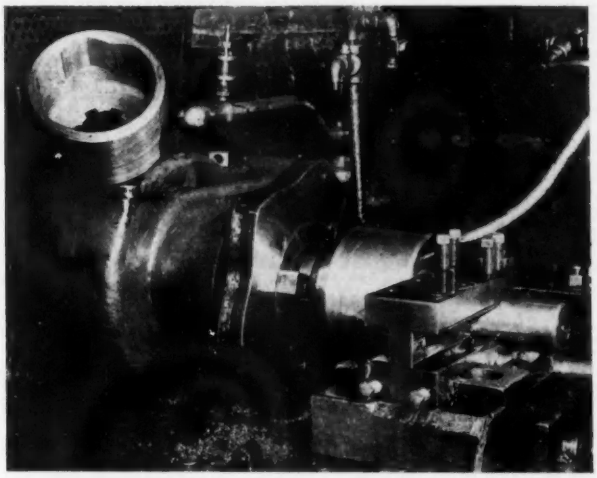
Considering the painstaking attention to detail in the line-boring of bearing lines and the selection of bearings, it is of interest to note the method used for checking bearing fits. Reverting to the line boring of cylinder blocks, it is found that the bore is checked by inserting a long, solid bar through the bore. This bar has a standard clearance and must fit so that it can be turned freely by hand. Similarly when the engine is on the assembly stand, after the bearing shells have been installed and the caps taken up, another bar simulating the diameters of the crankshaft journals is inserted through the line. This bar must be free to move by hand. Following this check the crankshaft is installed.

The latest piece of equipment installed at the time of the writer's visit to the plant is a chip reclamation unit, consisting of a crusher, a centrifuge, and a Bowser oil reclaimer. All metal chips from the machine shops are processed through this unit to remove and salvage the cutting oils.

In summary it may be said that Mack possesses one of the finest plants for the manufacture of heavy duty engines to be found in the industry. This is supported not only by the modernity of equipment and methods but even to a greater degree by the attention that is paid to quality control in every phase of the operation.

New Brunswick Plant

IN ITS program of specialized facilities, the Mack Manufacturing Corp. has established the New Brunswick, N. J., plant as the producer of transmissions, differential carrier assemblies, and gearing.



Example of special techniques developed here is this set-up on a small LeBlond lathe. It is fitted with the large cam attachment shown at the head stock, produces the specially-formed cavity in the part. (New Brunswick)

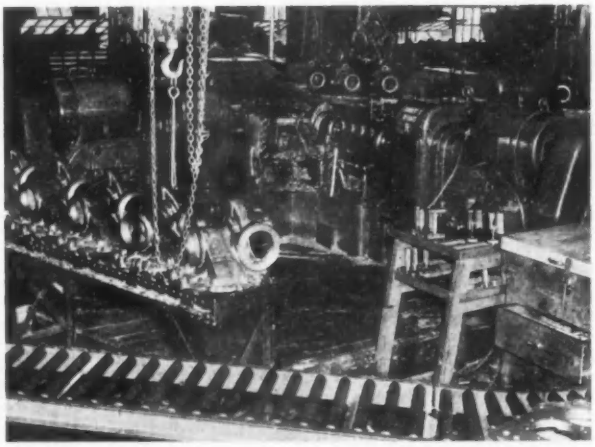
Currently this unit is making four different transmissions and four types of differential carriers for the assembly plant in Allentown. In addition to gear making, New Brunswick boasts a self-contained gray iron foundry equipped with the most modern mechanized facilities known to the art. Here will be found sand slingers for molding and core making, merry-go-round units for continuous molding; pouring lines; and a comprehensive system of conveyors and materials handling devices, among the latter being a major installation of Mathews gravity roller con-

Mack Brunswick Plant—Carrier Housing Routing

OPERATION	EQUIPMENT
Inspect casting	
Spray inside of housing with paint	Spray booth
Grind locating points	Bench
Rough & finish face flange & rough & finish turn hub	42 in. Bullard vertical turret lathe
Drill 8 holes and reamer drill 2 holes in flange & drill 4 holes in bearing cap bosses & ream 2 holes in flange	Natco Hydraulic drill press
Straddle mill main driving pin & rear axle shaft face and straddle mill spur pin shaft & bevel gear cover faces	Kearney & Trecker Milwaukee Mill — 4-spindle
Mill 4 bearing cap bosses	Kearney & Trecker Milwaukee Mill
Rough & finish bore & ream 4 large bearing holes	W. F. & John Barnes 4-way Boring Mill
Straddle mill torque arm boss	No. 4 Cincinnati miller
Drill 22 holes	Natco drill press
Countersink 24 holes & tap 8 holes & drill & tap 1 pipe thread hole	Carlton radial drill press
Tap 14 holes	Natco horizontal tapping machine
Spotface 1 hole, countersink & tap 6 holes, drive in 4 studs. Assemble 2 bearing caps to housing with 4 nuts.	Morris radial drill press
Spotface 7 holes, drill 1 & tap 1 pipe thread hole. Drill 6 holes in patent plate boss, drill 2 holes & countersink 7 holes	Radial drill press
Drill, rough & finish ream hole in torque arm & back spotface	Morris radial drill press
Rough & finish bore & ream and face bearing cap & bore clearance	Rockford boring mill
Mill clearance for bull gear	Becker vertical mill
Wash in xylol tank. Dry with air	Xylol tank
Remove all burrs & line ream 4 bearing holes & hand countersink all large bearing holes	
Chip off burrs & inspect for leaks	Bench
Chip & solder leaks where marked	Bench
Grind pinion face to square up with hole	Drill press
Check for runout on face of flange	Bench
Wash in xylol tank	Xylol tank
Dry with air hose & paint inside of carrier (if necessary)	Floor air hose
Inspect	Bench

Mack Brunswick Plant—Helical Gear Routing

OPERATION	EQUIPMENT
Inspect forging	
Normalize	
Inspect 10 per cent Brinell	
Tumblast	American Wheelabrator Tumblast
Rough & finish bore & ream hole, rough & finish face short hub; rough & finish face back long hub, rough & finish turn OD of gear and straddle face gear, form radii on OD of gear both sides and in hole both ends	Bullard Mult-Au-Matic
Remove burrs from ID of web at long hub side	Warner & Swasey turret lathe
Wash, grind off old part number and stamp part & lot number	Bench
Inspect	Bench
Rough hob teeth	Barber-Colman Hobber
Finish hob teeth	Gould & Eberhardt 16-H hobbing machine
Form chamfer on one side of teeth on both side of gear	Bench
Finish shave teeth	Michigan shaving machine
Broach keyway	LaPointe broach
Wash & remove all burrs	Bench
Inspect	Bench
Run in with soft master gear (if necessary)	Gleason running-in machine
Pack for carburizing	
Carburize	Hagen pusher type furnace
Inspect case	
Heat & quench in die	
Wash	
Descale	
Inspect 100 per cent Brinell, 100 per cent file, 100 per cent distortion	
Grind hole and face of long hub	Heald Size-Matic grinder
Grind face of short hub	Heald surface grinder
Demagnetize	Bench
Wash	
Remove all burrs	Bench
Inspect and send to finish gear storage	Bench
Grind off all burrs	Bench
Lap against hard mating gear	Lapping machine
Run in with hard mating gear and send to assembly dept.	Gleason running-in machine

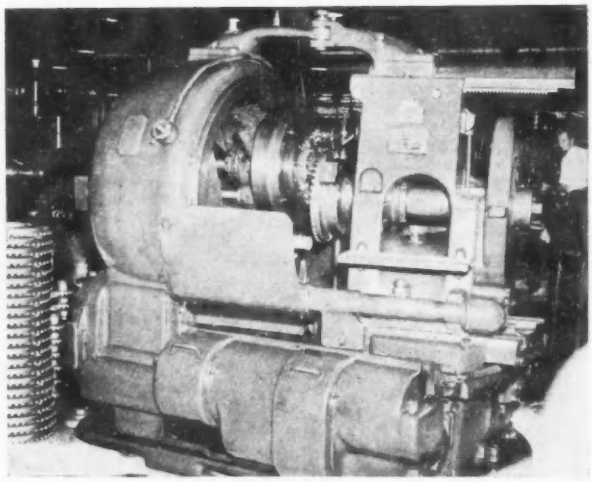


This unusual machine is the special four-way W. F. & John Barnes horizontal boring machine designed for boring differential carrier housings in a single setting at the Mack New Brunswick plant.

veyors. The foundry supplies cylinder heads, cylinder blocks, flywheel housings, etc., for the Plainfield engine plant, also transmission cases for New Brunswick.

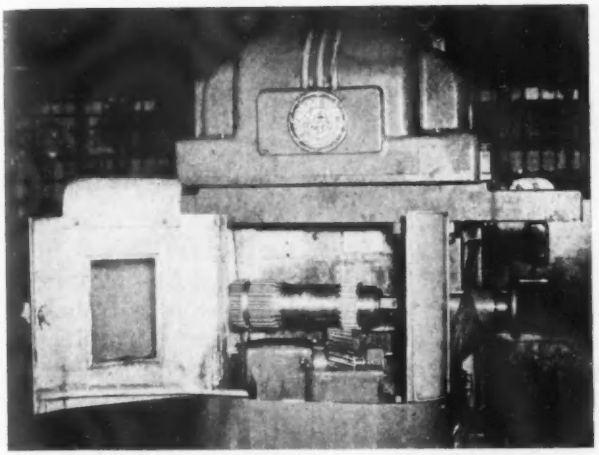
Foundry quality has been placed upon an exceptionally high level comparable with that of the best non-ferrous practice for aircraft engine parts. This will be evident from our later discussion of foundry operations.

Gear manufacture has been patterned along the most modern practice, utilizing familiar items of equipment of the latest type. Most gears are rough- and finished-hobbed, then shaved on Michigan Tool rotary shaving machines. All gears are lapped in pairs or sets before assembly. The qualifications for this kind of gear production are well known to specialists in automotive gear plants. It is also of interest to note the painstaking attention to detail in the manufacture of spiral bevel gears. Recognizing that each new lot of steel may respond in different manner to heat treatment, the gear department tests each new lot of steel individually. For this purpose, they cut sample sets of gears, put them through the entire manufacturing process to note the distortion, then make suitable corrections in the adjustment of gear cutting equipment. Such procedures are recognized as an integral part of the process of modern gear manufacture.



View in the axle department (New Brunswick) for a close-up of one of a large battery of the latest type Gleason helical gear generators used in producing spiral bevel gears.

Needless to say, metallurgical control is a major activity in both the gear plant and foundry. It begins with the raw materials—steel at the mills, sand, pig, scrap, etc.—extends to the heat treating depart-



Looking into the work-station of one of the new type Michigan gear finishing machines employed widely at New Brunswick for the shaving of transmission gears.

Many of the gear blanks are turned and bored on heavy-duty Potter & Johnston turret lathes fitted with cemented-carbide tools. (New Brunswick)

ments in the gear department and all phases of foundry operation. For the control of gear steels, Mack metallurgists have adopted the well-known Jominy hardenability standards which are established as

(*Turn to page* 86, *please*)

Mack Brunswick Plant—Countershaft Routing

OPERATION	EQUIPMENT
Inspect forging	
Normalize	
Inspect Brinell	
Shotblast	American Wheelabrator Tumblast
Straddle mill to length and center both ends	Davis Thompson rotary mill
	Sundstrand centering machine
Turn both ends	LeBlond multi cut lathe
Grind 2.1265 in. dia. & face of shoulder, grind OD of small & large gear	Landis grinder
Grind 2.6275 in. dia. & face of gear & grind 1.7726 in. dia. & face of shoulder	Norton grinder
Wash, stamp part & lot numbers & remove all burrs	Bench
Inspect	Bench
Rough & finish shape 17 teeth	645-A Fellows gear shaper
	No. 7 Fellows gear shaper
Rough & finish hob 20 teeth and 13 teeth gear	No. 12 Barber-Colman hobber
	"A" type Barber-Colman hobber
Test teeth of 17 tooth gear	Bench
Test teeth of 20 tooth gear	Bench
Test teeth of 13 tooth gear	Bench
Tooth round 13 teeth on small gear one side	Cross tooth rounder
Tooth round 20 teeth on large gear one side	Cross tooth rounder
Wash	
Remove all burrs	Bench
Burnish teeth of 17 tooth gear	Cincinnati burnishing machine
Burnish teeth of 20 tooth gear	Cincinnati burnishing machine
Burnish teeth of 13 tooth gear	Cincinnati burnishing machine
Run-in 17 tooth gear with hard gear	Gleason test machine
Run-in 20 tooth gear with hard gear	Gleason test machine
Run-in 13 tooth gear with hard gear	Gleason test machine
Wash	
Inspect	Bench
Copper plate large end	
Copper plate small end	
Inspect copper plating	
Pack for carburizing	
Carburize	
Inspect case	
Draw end in lead pot	Hagen pusher type furnace
Wash	
Inspect 100 per cent Brinell, 10 per cent Scleroscope	
Remove copper and descale	
Inspect file test 100 per cent	
Clean centers and straighten	Hannifin straightening press
Inspect pitch dia.	
Grind 2.1265 in. dia. and face of small gear	Norton grinder
Grind 2.6275 in. dia. and face of gear	Norton grinder
Grind 1.7726 in. dia. and face of shoulder	Norton grinder
Mill keyway & spline mill runout of keyway	Taylor & Fenn spline mill
	Cooley & Edlund miller
Mill slot in end of shaft	Cincinnati mill
Hob 2⅝ 12 in. USF—R.H. thread on large end of shaft	Pratt & Whitney thread miller
Hob 2⅛ 12 in. USF—L.H. thread on short end of shaft	Pratt & Whitney thread miller
Wash	
Remove all burrs	Bench
Inspect and send to finish gear storage	Bench
Run-in 17 teeth gear with hard mating gear	Gleason test machine
Run-in 20 tooth gear with hard mating gear	Gleason test machine
Run-in 13 tooth gear with hard mating gear	Gleason test machine

Automatic Temperature

By Morton E. Moore
Research Group, Engineering Division
Douglas Aircraft Co., Inc.

MODERN airplanes have made high-speed recording of flight-test information necessary. Owing to their high rate of climb, the outside air temperature, altitude, power, and other conditions change rapidly, and less time is available in which to obtain the required information. Automatic recording is necessary because test pilots and flight engineers of modern airplanes simply have too much to do. In addition, more temperature measurements are necessary, because more power is packaged in a single unit.

With the advent of a successful high-speed, automatic temperature recorder it became apparent that methods of flight-test temperature measurement could be improved. Up to that time temperature measurements were made with a manually-balanced laboratory-type potentiometer and a group of manually-operated switches. It was necessary for the flight engineer to switch the potentiometer from one thermocouple circuit to another, and to then manually balance the instrument and to record the reading. This procedure was tedious, and only limited data could be recorded. The appearance of the automatic recorder removed these restrictions, and it only remained to devise a suitable automatic control system for use with the recorders to make it unnecessary to manually switch from point to point and record the readings upon a data sheet. The system to be described has largely

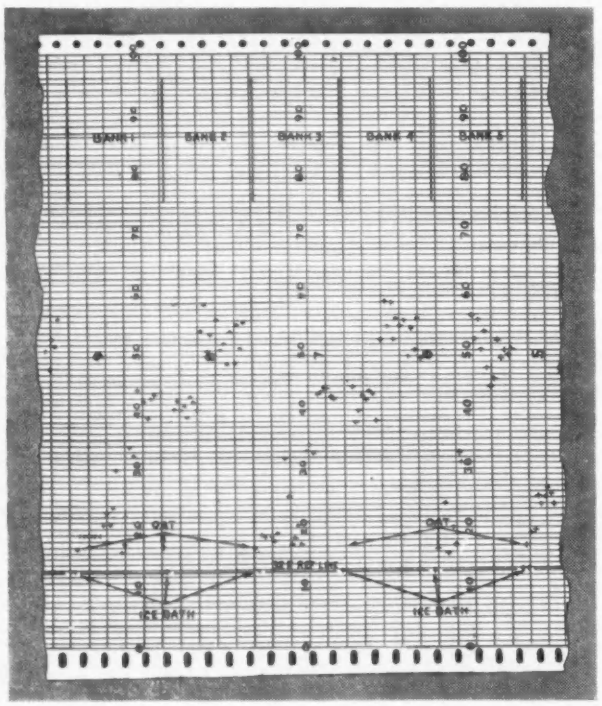


Fig. 1—Typical chart obtained in flight with automatic temperature recorder.

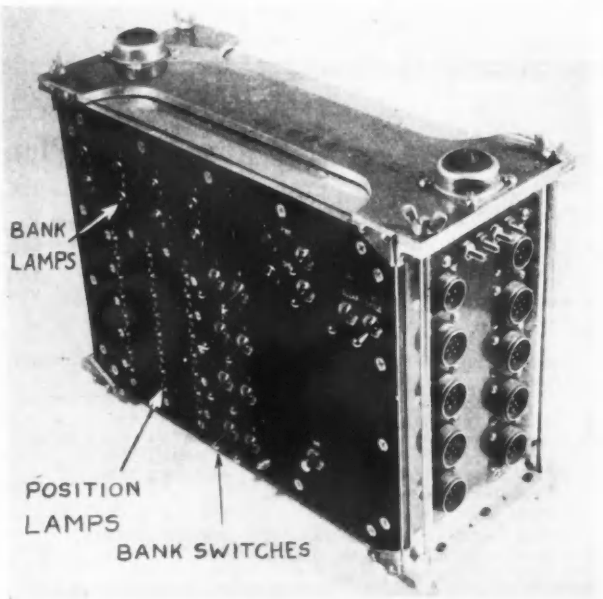


Fig. 2—Control panel.

eliminated the remaining difficulties. It has made it possible to obtain more temperature information in a much shorter time with equal, if not greater, accuracy than was previously possible. At the same time it leaves the flight engineer free to spend the major portion of his time at other duties.

The system developed by the Douglas Aircraft Co. is designed to enable an automatic temperature recorder to measure and record a series of temperatures automatically in a regular sequence. It consists basically of a number of switching units and a master control panel. The switching units connect the thermocouples in the proper order, there being 24 couples to each switching unit. The control panel controls the selection of switching units in the proper sequence and indicates the couple which is being measured at any given time. The system is controlled by an im-

Recording Control System

for Flight and Test Stand Work

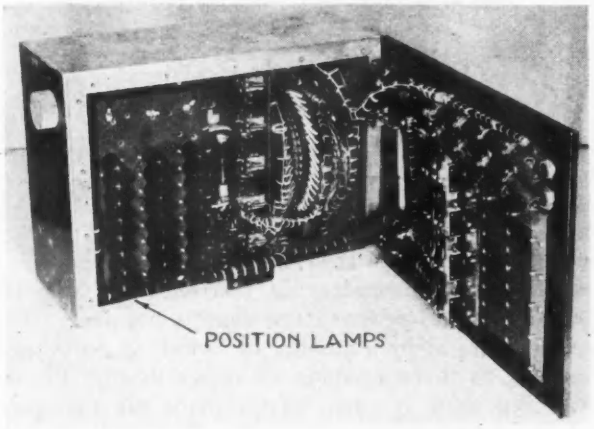


Fig. 3—Inside control panel at front.

pulse obtained from the automatic recorder, which is supplied by the instrument at the time it has become stabilized and recorded the temperature of the point under measurement. The system thus provides for the selection of groups of 24 thermocouples, corresponding to the 24 couples of each switching unit, in any desired sequence of such groups, and will accommodate eight switching units. While designed primarily for use in flight test work, the system also may be applied to test stand work.

The system may be adapted for use with any automatic temperature recorder that provides an impulse after the instrument has been stabilized and the temperature recorded. On the recorders used by Douglas this impulse is obtained from a switch which is actuated by the printing mechanism each time the printing head is lowered to record a temperature. The impulse advances the switching units one position, to the next thermocouple in order, thus making it possible to go through the points one by one in order. A typical record obtained in flight is shown in Fig. 1. It will be noted that two important principles are employed. First, all temperatures falling within a reasonably narrow range are grouped together. This speeds up the recording, as the printing head needs to travel only a short distance each time a new couple is selected, instead of possibly from near one end of the scale to the other; second, a certain pattern is employed to identify the various switching units or "banks." Thus, starting from the reference pattern, the temperatures are recorded in time sequence on the chart, and hence may be recognized. Were this not done, it would be virtually impossible to tell from the record what point of measurement a given print represented.

In the development of the system several basic design considerations presented themselves. If it were to be completely successful, it obviously must be fully automatic. It must be dependable, and not depend for

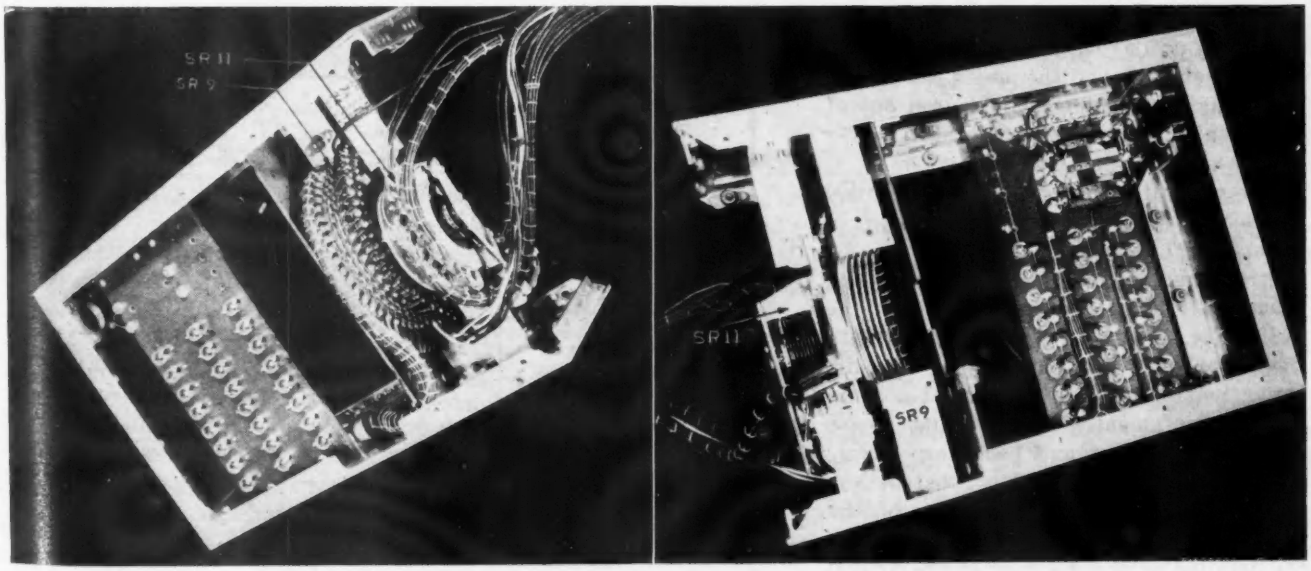
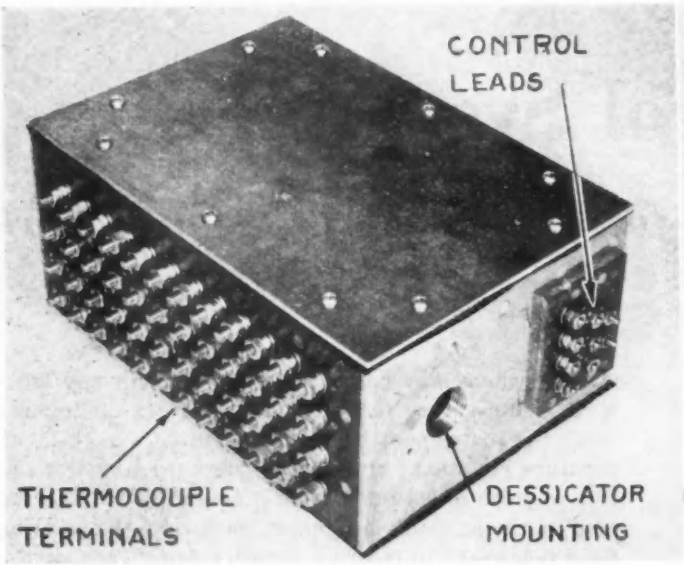
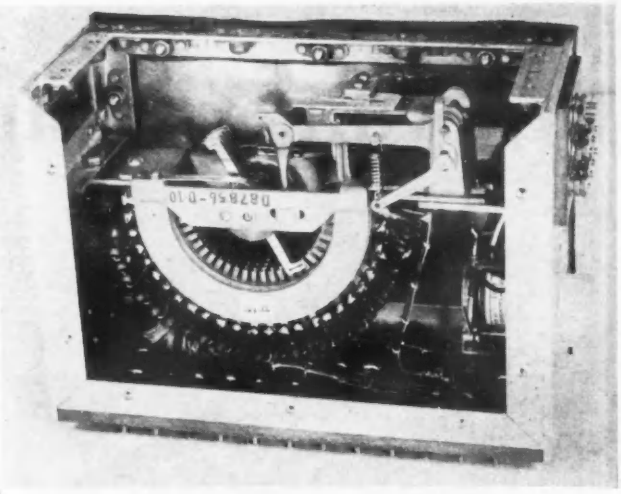


Fig. 4 (Front) and Fig. 5 (Back)—Control panel during construction.





Figs. 6 and 7 — Views of the switching units.

its proper operation upon a large number of interdependent units. It must consist of units of such size that space for them can be found even in small airplanes. Further, the system must be flexible. This requirement was met by breaking it down into a master control panel and a number of separate switching units, up to eight of which may be used with one panel. These units may be located where convenient. By locating the switching units near the source of temperatures, the length of thermocouple leads may be reduced. Large bundles of thermocouple wires, etc., are not desirable, as the length of such leads changes with each installation, and, besides, space is not always available for a large bundle of such wires.

The control panel provides the means by which the switching units are caused to operate automatically. It further indicates the point under measurement at all times, and also gives a positive check on the operation of the system. These functions are covered by the basic control circuit. An electronic amplifier, associated with and built into the control panel, provides a further check on the system, and also provides a means of synchronizing the switching units with the control panel following servicing of the units, or in the event that the system should drop out of synchronism due to temporary power failure or any other cause.

The general arrangement of the control panel and switching units is shown in Figs. 2 to 7 inclusive. Fig. 2 shows the control panel mounted in its cradle and illustrates the general arrangement of the unit. Fig. 3 shows the control panel with the front swung open, showing the arrangement of the position lamp bank and of the equipment. Figs. 4 and 5 are views of the front and back respectively of the control panel during construction. Figs. 6 and 7 present two views of the switching units. Figs. 8, 9 and 10 show the detailed wiring diagram of the control panel, electronic amplifier, and switching units respectively on this and the following page.

Some means of switching the recorder from one point of measurement to the next is required. This is taken care of by a number of switching units, each handling 24 thermocouples, as shown in Fig. 10. The switching units in turn must provide the following:

1. A method of switching both sides of the thermocouple circuit, in order to eliminate common returns.
2. A method of identifying at the control panel which switching unit is in operation.
3. A means by which it is possible to tell if the switching unit is in step with the position-indicator lamps on the control panel, and a means by which it is possible to bring them into step automatically if they are out of step.
4. A means by which the unit is disconnected from the recorder thermocouple circuit after the control panel has gone through the cycle of operation of the particular switch unit, thus preventing a "jammed" switching unit from making the rest of the system inoperative.

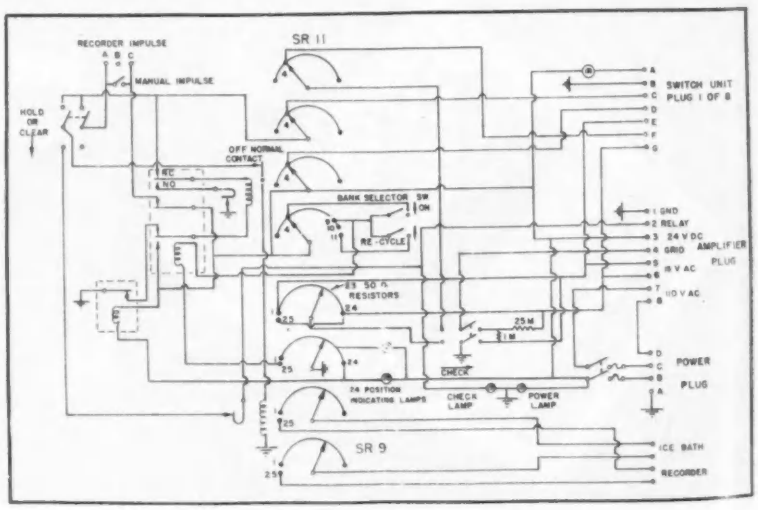


Fig. 8—Control panel wiring diagram.

These functions are accomplished by the four levels of the 25-point rotary switch, in order from top to bottom, and the auxiliary relay R41, as shown in Fig. 10. The 25th position of the switching unit is the "off" position, in which it is left when not in operation. The third level of the rotary switch runs directly to the bank lamp circuit on the control panel. When the switch is in operation, the corresponding bank lamp on the control panel is lit. This feature provides a positive check on the operation of the system, for if the bank lamp is not extinguished when the control panel advances to the next switch unit, the switch unit is obviously "jammed." The fourth level of the rotary switch forms one pair of arms of a bridge circuit. The other pair consists of a similar resistor bank on the position-indicating switch of the control panel. The bridge circuit thus formed, in connection with an electronic control amplifier, fulfills the third function enumerated above. The operation of this part of the system will be described elsewhere.

Iron and constantan wires are used throughout the thermocouple portion of the circuit, between the rotary switch and the terminal blocks, etc., to minimize errors arising from possible temperature gradients within

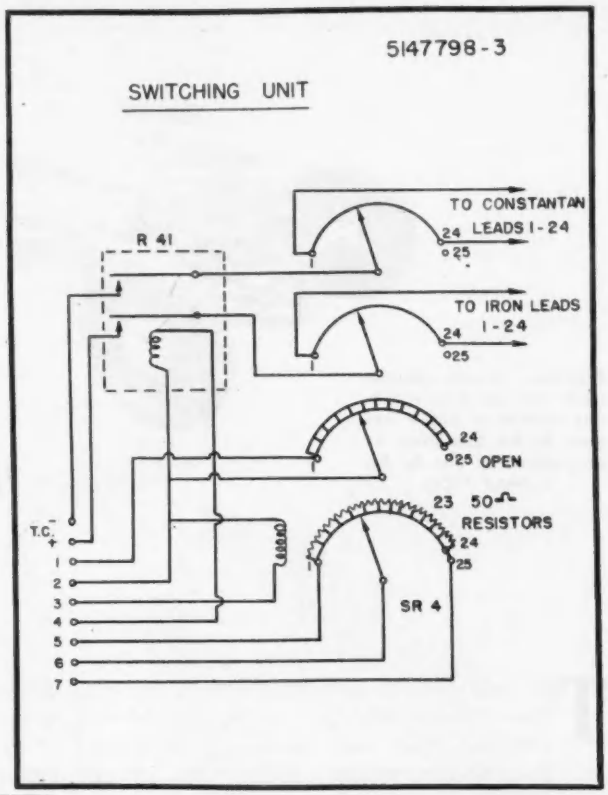


Fig. 10—Switching unit wiring diagram.

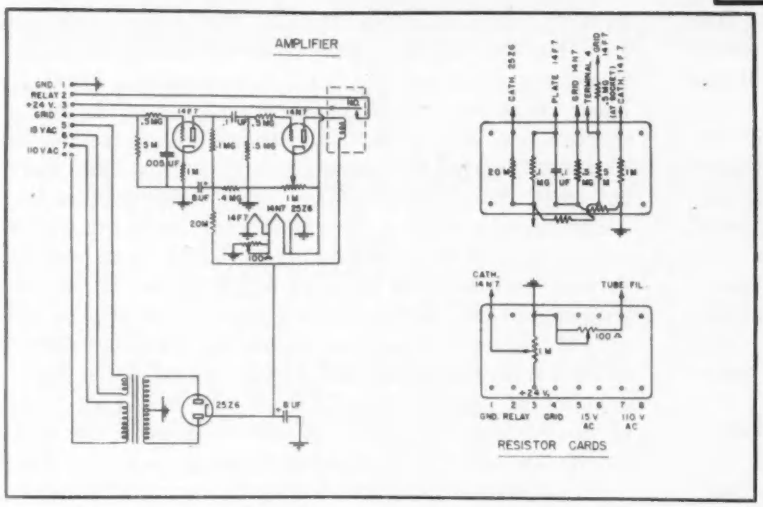


Fig. 9—Electronic amplifier wiring diagram.

the box. Switching units constructed in this manner have been subjected to cold-room tests to simulate the temperature gradient encountered in a rapid descent from high altitude, as in a dive. The maximum error caused by an initial temperature difference of 140 deg. F was found to be approximately 3 deg. F. Approximately the same error occurred with standard, manually-operated thermocouple switches under the same test conditions.

As mentioned previously, the control panel allows of the proper selection of the switching units, and also provides the means by which the point under measurement may be identified. The 11-point rotary switch S.R. 11 of Fig. 8 selects the proper switching units. The terminals 1 to 7 of the switching unit connect in order to terminals A to G of the control-panel switch unit plug. S.R. 11 switches, in order from top to bottom level, the signal input lead to the grid of the amplifier obtained from the two arms of the bridge circuit of the switching units, the coil circuit of the switching unit motor, and completes the coil circuit of the auxiliary relay R41 of the switching unit. The fourth level of S.R. 11, in conjunction with the bank selector and re-cycle switches, provides a portion of the circuit by which S.R. 11 itself is controlled. The impulse circuit, shown in the upper left-hand corner of Fig. 8 when closed completes the coil circuit of the motor of the switching unit and the 25-point rotary switch of the control panel (S.R. 9), and thus energizes the motors of these rotary switches, causing the switches to advance one point for each impulse from the recorder. The 25-point rotary switch of the control panel switches the remaining pair of arms of the bridge circuit, the position-indicating lamps of the control panel, and the reference thermocouple ice-bath circuit.

Henceforth the switching unit of Fig. 10 will be referred to as Switching Unit No. 4, and is one of eight provided for in the system. By making use of two spare points of S.R. 11, up to 10 switching units may be handled by the control panel. However, is was felt that eight was about the maximum number of switching units which the flight engineer could be expected to familiarize himself with, and that this number also

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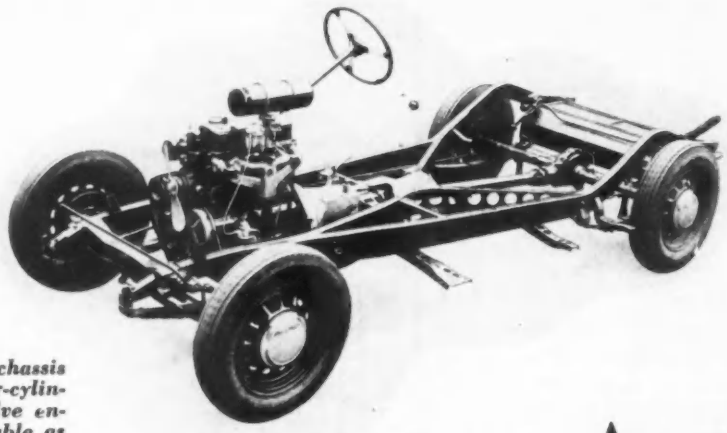


Postwar Austin chassis with 58 hp four-cylinder overhead valve engine to be available as an option to the 42 hp L-head type.

By M. W. Bourdon
Special Correspondent of AUTOMOTIVE *and* AVIATION INDUSTRIES in Great Britain

British Austin Co. *to Build New* Model

THE first specific announcement to be issued about the postwar plans of British automobile manufacturers has been made by the Austin Motor Co. It relates to a new model with optional engine sizes that had been made ready for production prior to the London passenger car show of 1939, which would have been held in October of that year but for the outbreak of war.

In September, 1939, a few days after war was declared between England and Germany, particulars were published about a new Austin Twelve, a five-passenger car with a 94 cu in. L-head engine (12 rated hp) developing 42 bhp at 4000 rpm. But it has now been revealed that for practically the same chassis and the same body, though with a higher rear axle gear ratio, a 134 cu in. engine (16 rated hp) had been developed and was ready for production when war broke out.

These prewar plans for production of a new Austin with either engine are to be revived and put into effect as soon as possible after the end of the war. Other prewar models, both smaller and larger, will also be put into production again for the time being—until the real postwar cars are ready to supersede them.

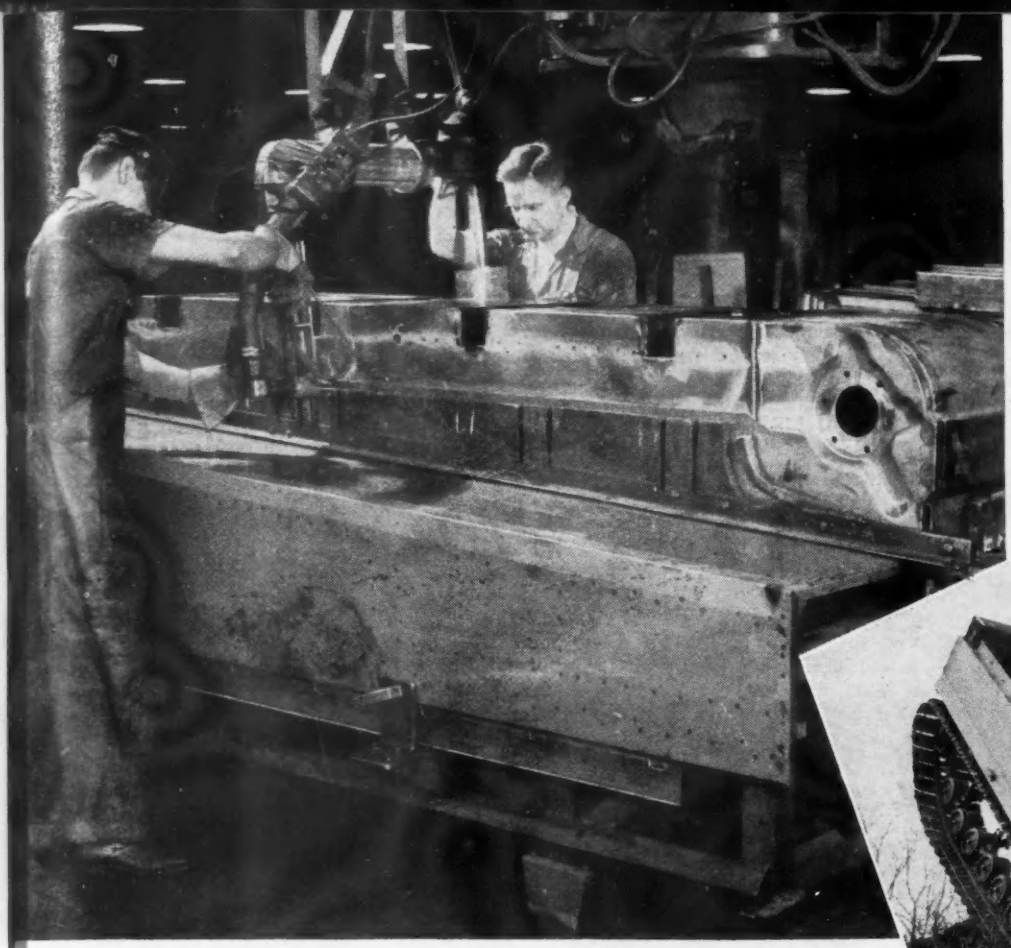
Although not so stated by Austin, it is evident that there is expectation that the new Austin Sixteen with the lower weight power ratio (unusually low on British standards, as shown hereafter) gained from the larger engine will assist materially in securing re-entry into export markets, as well as having forcible appeal to British buyers capable of appreciating excellence in high-gear performance.

The higher output engine for the slightly modified chassis has four cylinders, like the Twelve engine, but it differs from Austin practice hitherto in that it is the first standard passenger car engine of this make to have overhead valves, though Austin truck engines have had this feature since their introduction two or three years before the war. Pushrod operation is used. With a piston displacement of 134 cu in. and a compression ratio of 6.8 to 1, this engine develops 58 bhp at 3700 rpm and a maximum torque of 108 lb-ft at 1900 rpm. When fitted with this engine the weight/power ratio of the car is 48.2 lb per hp, which compares with 63 lb per hp when the 94 cu in. engine is used and with an average of 59 lb per hp in the case of prewar 12-16 hp British cars. With the higher output engine the increase in maximum engine power is 38 per cent and in car weight only 5.5 per cent. In view of the additional power, the rear axle ratio of the Sixteen is 4.1 to 1 as compared with 4.89 to 1 on the Twelve. Tires are 5.50 x 16 in. in both cases.

The electrical equipment is a 12-volt system. Ignition timing is effected by a combination of centrifugal and vacuum control. A 40 mm. Zenith downdraft carburetor is used, with siamesed inlet ports leading

(*Turn to page* 74, *please*)

The Austin Sixteen with standard saloon body (sliding "sunshine" roof).



Welding the hull for a "Weasel." Three submersion tests are made to assure water tightness.

Deep mud or steep hills cannot stop the fighting "Weasel."

THESE "WEASELS" FIGHT

Mud, sand, snow, water — they all are the same to the Studebaker Corporation's "Weasel," officially known to the combat forces as the M29 cargo and personnel carrier. Powered by a standard six-cylinder Studebaker Champion engine, this track-laying vehicle is designed to strike swiftly and stealthily over a greater variety of terrain than any other military conveyance.

Inland's part in the production of "Weasels" was to furnish 18-gage Hot Rolled Pickled Sheets for the all-welded, watertight hull; 7 and 9-gage steel for hull reinforcements; 10-gage sheets for cold pressed guide wheels; 13-gage steel for the cold formed bogie wheels and silicon manganese spring steel bars for the four springs on each "Weasel."

Inland has maintained a remarkable record of "on-time" deliveries and uniform high quality—performance that has speeded many "Weasels" to fighting fronts throughout the world.

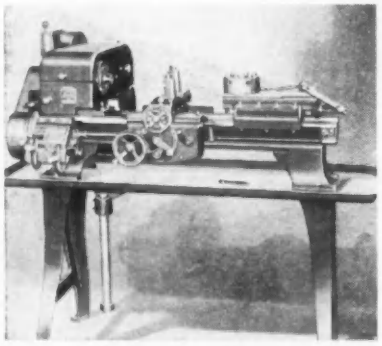
Inland Steel Company, 38 S. Dearborn Street, Chicago 3, Illinois. Sales Offices: Cincinnati, Detroit, Kansas City, Milwaukee, New York, St. Louis, St. Paul.

Bars, Floor Plate, Piling, Plates, Rail, Reinforcing Bars, Sheets, Strip, Structurals, Tin Plate, Track Accessories.

INLAND STEEL

New Production Equipment

LOGAN ENGINEERING CO., Chicago, Ill., is introducing the Logan No. 840 quick change gear turret lathe which handles bar stock up to ⅝ in. diameter. Typical of its design are such features



Logan No. 840 quick change gear turret lathe

as precision preloaded ball bearing spindle mounting, adjustable gibs to compensate for wear of turret and cross slide, and self-lubricating bronze bearings at 35 points in the lathe.

The quick change gear box provides 48 threads and feeds, in either direction, to the carriage. Adjustment of two levers makes screw threads of from 8 to 224 per in. quickly available, and by changing the 24-tooth stud gear for the 48-tooth stud gear furnished with the lathe, additional threads of 4 to 7 per in. are equally accessible. Similarly, longitudinal power feeds from .0015 in. to .1000 in. per revolution of the spindle may be obtained.

NATIONAL BROACH AND MACHINE COMPANY, Detroit, Mich., has just brought out the S.I.G. internal gear checker, the function of which is to check tooth spacing, eccentricity, pitch diameter and root diameter of spur or helical internal gears from 3 to 64 diametral pitch and from 2-in. to 18-in. pitch diameter. With an auxiliary head, parallelism of spur gear teeth may also be checked.

The principal elements of the machine are a rigid base, the top of which is finished, a work spindle mounted on precision anti-friction bearings, an adjustable counter-weighted column, and the checking head carried on the end of an overarm, adjustable axially to and from the work spindle axis to accommodate gears of varying diameter.

The checking head spindle at right angles to the work spindle is spring loaded to advance it toward the work gear teeth. Spring pressure is adjustable. The spindle is retracted by means of a hand lever at the front of the checking head.

At its forward end the checking head spindle carries a rigid ball pointed contact finger and a movable pivot finger, the latter actuates the spindle of a one-ten-thousandth indicator on which errors in tooth spacing or index are read.

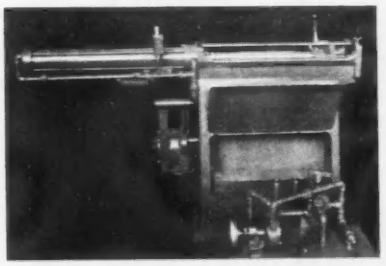
The rear end of the checking head spindle carries an arm which contacts the spindle of a .0005 in. indicator on top of the checking head to register the axial movement of the checking head spindle in measuring eccentricity errors of pitch diameter and root diameter.

An adjustable gear tooth locater

S.I.G. internal gear checker

mounted on the table positions the work gear with reference to the ball point contact finger and prevents skipping a tooth when indexing the work gear.

BUILT to meet the demand for a fast, accurate machine of small size, the American H-1-20 horizontal 1-ton broaching machine, made by American Broach & Machine Co., Ann Arbor, Mich., is suitable for pull broaching and push broaching on certain types of work, and also for light push assembly jobs. It handles pull broaches up to 23½ in. long, and has a maximum stroke of 20 in. Maximum time for the



American H-1-20 broaching machine

full cutting stroke is 4½ seconds. Approximate speeds are 18 to 24 fpm, the speed being controlled through an automatic diameter changing pulley. The pressure gage is mounted so that it may be read from either side of the hydraulic cylinder by opening the side desired. Control is by a hand lever operating a 4-way hydraulic valve.

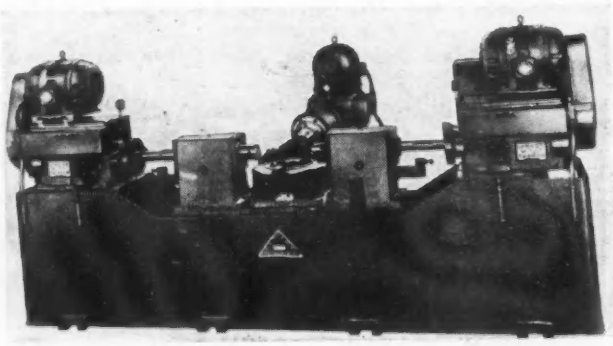
A SPECIAL horizontal 3-way machine for boring five holes and facing four holes in a truck axle mounting, or carrier, has been designed and built by LeMaire Tool & Mfg. Company, Dearborn, Mich.

It consists of two heavy-duty spindle quill assemblies on a main base, with another assembly (slide type) of two spindles at right angles to these mounted on a rear base. All three are actuated by LeMaire No. 5000 twin ram hydraulic units.

All parts are rough bored and finished faced in one operation at a rate of 40 pieces per hour at 100 per cent efficiency. A second operation is required for finish boring all holes to .001 in. tolerance.

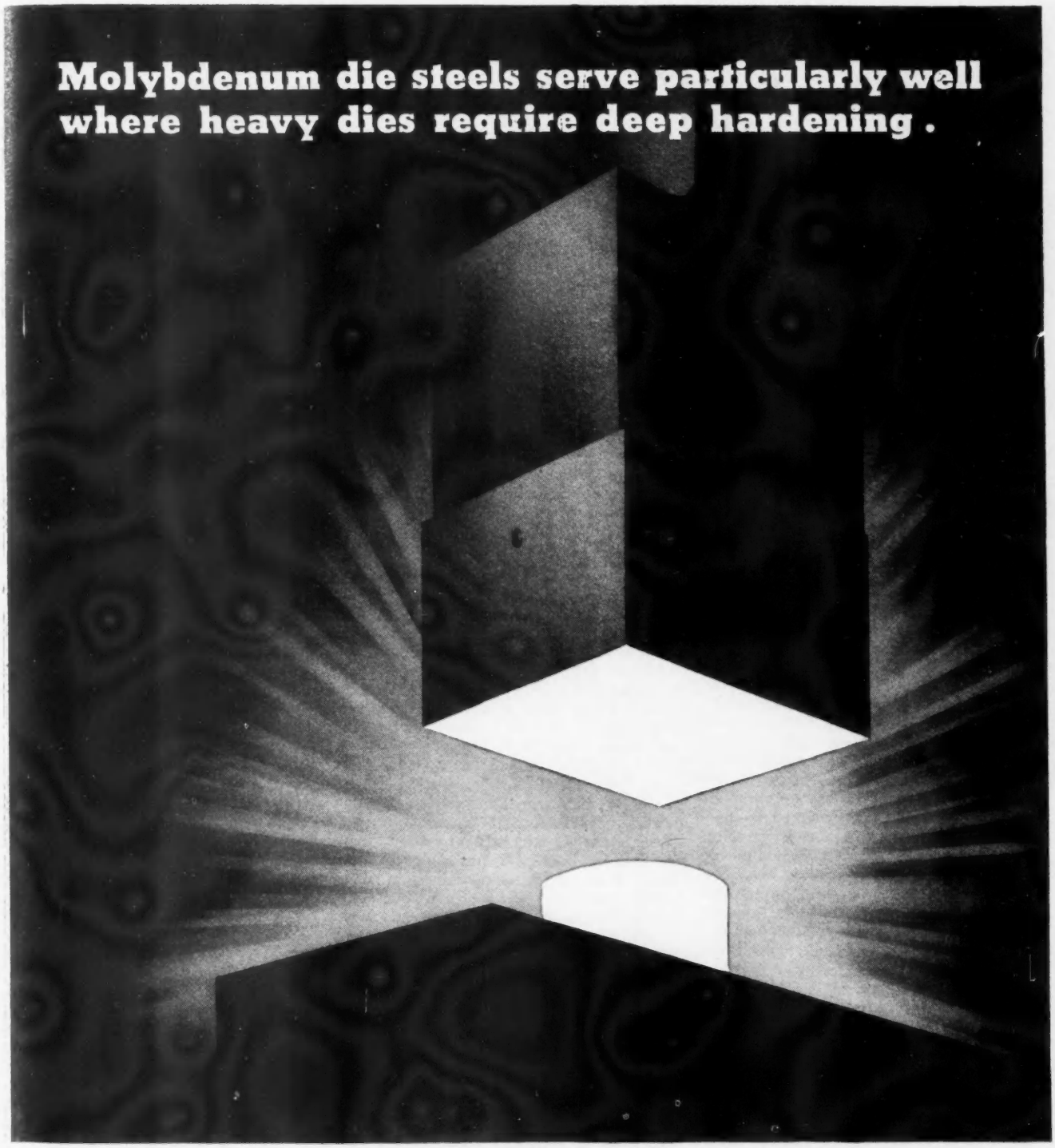
The spindle quill assemblies are mounted on precision bearings for guiding the boring bars and maintaining accurate alignment. LeMaire Units serve to rotate and feed the tools through the flexible joints.

(*Turn to page* 67, *please*)



LeMaire special horizontal 3-way machine

Molybdenum die steels serve particularly well where heavy dies require deep hardening.



CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company

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MOLY

Airbriefs

By Henry Lowe Brownback

Liquid-Cooled Engines

From time to time we have talked of the old question of liquid-cooled versus aircooled engines. Our big aircooled radial engines have been doing an outstanding job and they are fine power plants. In fact the liquid-cooled engine had just about been liquidated in the United States at the outbreak of the war. In Britain, the Rolls-Royce kept its lead in spite of the competition of aircooled engines and in France Hispano Suiza carried the banner although part of its production was aircooled. In Germany Mercedes—Benz led the parade in gasoline engines and Junkers in Diesels—both liquid cooled.

The large aircooled radial engine has been most reliable in big transport operations and long distance bombing and we would probably have had much greater losses had these large planes been liquid cooled with "plumbing" which could have been pierced by bullets. The future, however, is growing less clear as these large aircooled power plants must be so cowled that they are difficult to get at during flight and their operating temperatures are so close to maximums that conditions must be pretty nearly right to keep them going without trouble.

I have been looking for some time for a rebirth of the radial liquid-cooled engine which combines many of the advantages of both types. The idea is old, the first radial aircraft engine (The Manly) having been liquid cooled and at Anzani we built a 20-cylinder job that could turn out about 900 hp, which was really something in those days.

My mind was turned toward the liquid-cooled engine a few days ago when I received a letter from my friend Arthur Nutt, who certainly was the leading technical expert on water-cooled engines in the 1920's when the Curtiss was the leading liquid-cooled engine in this country, if not the world. Later when the military services demanded aircooled engines Curtiss dropped the liquid-cooled and Mr. Nutt headed the development of the famous Wright Cyclone series. His letter, to my surprise, came on the stationery of Packard. Thus, while M. Nutt has gone back to his old love—the liquid-cooled engine, he has severed his connection with Curtiss, one which he has kept during his whole career being one of the few aircraft engine industry executives who has not shifted from one plant to another. I toast him success in his new connection and only wish that I could look behind the curtain and see whether it means a stepping up of Packard-Rolls Royce activity or some new Packard engines of original design.

Jet Propulsion

While wasteful of fuel, jet propulsion is really under way in earnest. This type of propulsion is old as the hills and for years ship designers have tried to make it work in boats of all kinds. European canal boat designers tried to apply it to their boats, but the boats went so slowly and the jet had such high velocity that it was a poor propulsion device, but a good dredge. In aircraft, at its present state of perfection it is in about the same class as aircraft propellers are in driving boats. I have, for years, built some boats using aircraft propellers driven by aircraft engines. Where the boat is heavy and has lots of resistance, the air propeller has low efficiency as compared to the marine propeller, but where the boats travels at extremely high speed with very little resistance, it can be more efficient than the marine propeller. A few days ago I saw one of the seaplanes equipped with rocket take-off jets get off of the water and climb to altitude. The take-off was done in such a short run that it seemed unreal and the climb made one used to ordinary propeller driven planes shudder as the ship was in an attitude which would have been a complete stall without the rockets. Perhaps this war accelerated device will solve many of our postwar problems.

Propellers

The thought of rockets and jets naturally leads one to the problems of propellers as we have known them. So much work has been done on props and so much data collected from the laboratory and field that it would seem that propeller designing should be an exact science. We have been told that certain tip speeds cannot be exceeded without destroying efficiency and yet I have been told by different men who have returned from the European theatre that they have fitted many of the bombers with props having maximum tip speeds at cruising rpm and far above that during take-off. They tell me that the take-off at low pitch has improved and that over-all efficiency of operation has greatly increased.

We have often laughed at a cartoon called "Born 30 Years Too Soon," but that has been the tragedy of many scientists and inventors. While there is increasing pressure being brought to bear to cheat the inventor out of his profits, copyright owners get rights which protect them for years and their heirs for more years. Years back, in fact almost at the dawn of aviation, Lucien Chauviere in France and Heath in the United States patented propellers having variable pitch, including feathering and reverse. Both of these propellers had blades which could turn in the hub and which were actuated by planetary gear mechanisms. At this time there was no great demand for such devices and the weight which they added to the planes was a negative factor, which outbalanced the positive advantages of controllable pitch. It was only when loadings became so high that getting maximum power out of the engine spelled the difference between taking off from a given area or not, and when multi-motored planes were designed which could fly with one engine dead, but which had to have a propeller on the "dead" engine that could be feathered in order to prevent the propeller from windmilling, thus wrecking the engine and possibly the the plane, that the inventions of these great men met with a commercial demand and by that time their patents had become past history, which spelled loss of time, effort and money for the inventors. Colonel McCoy of the AAF has written a most illuminating paper showing just how necessary the controllable pitch propeller is in modern aviation. He states that an emergency requiring feathering occurs, in this country, on an average of once in every 3000 hours of engine operation and that precautionary featherings take place as often as once in every 250 hours. Colonel McCoy states "It is significant that Pan American Airways' experience with the Boeing 314 flying boats shows that 85 per cent of engine troubles requiring feathering may be repaired during flight." Further in his paper the Colonel states, "It is imperative that full feathering be accomplished in a minimum of time. The worst flight condition requiring fast feathering occurs during take-off."

One interesting observation is that some automatic means be provided to indicate which engine in a four-engined job is not functioning properly as the malfunctioning of one engine often produces such severe vibration in the in-

(*Turn to page 76, please*)

INSURANCE AGAINST

- ASSEMBLY COMPLAINTS
- OIL LEAKS
- COMPRESSION LOSS
- WATER SEEPAGE
- CORROSION
- HEAD SEIZURE

Why not make sure that all assemblies are leakproof and pressure tight?

No oil leaks . . . No water seepage . . . No compression losses. Form-A-Gasket holds tight against gasoline, kerosene, lubricating oil, grease, fuel oil, cold or hot water, salt water and anti-freeze.

Keep the "come backs" away from your door . . . Use Permatex Form-A-Gasket!

Form-A-Gasket No. 1 is a paste that dries fast and sets hard.

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Aviation Form-A-Gasket is a heavy liquid that sets quickly but does not dry.

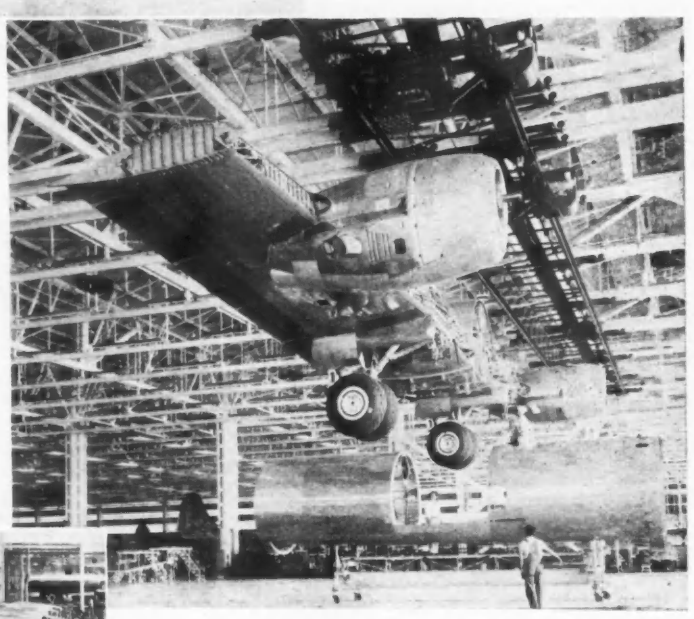
PERMATEX COMPANY, INC. BROOKLYN 29, NEW YORK, U. S. A.

(Left) Exploded view showing final assembly units of a B-29 Superfortress.

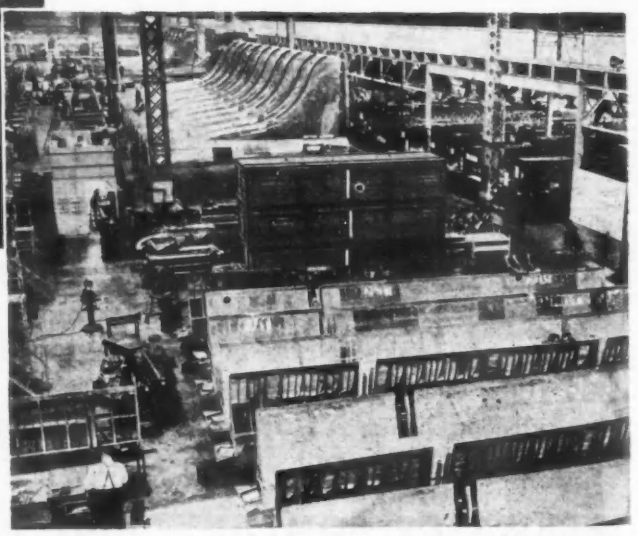
(Below) A 17-ton main center wing section being lowered by two 20-ton cranes into the fuselage bomb bay section during assembly of a B-29 at Wichita, Kansas, Division of Boeing.

B-29s in Production

at Boeing Plants



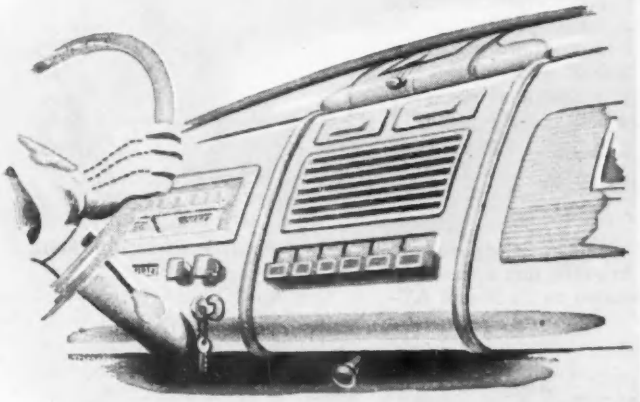
(Left) All sections for B-29s advance one position in a mass movement at the end of each 6 hr 40 min at the Wichita plant. The nose section line is shown here.

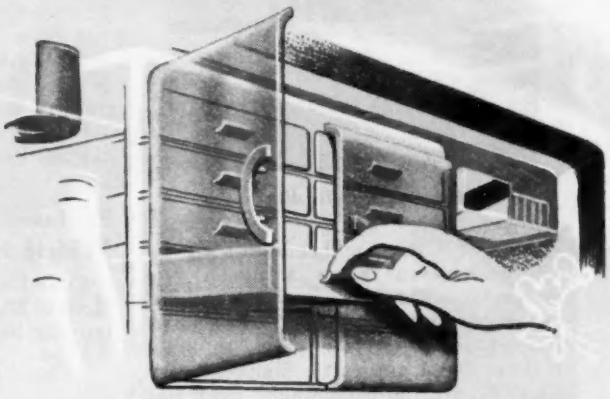


(Right) B-17 and B-29 assemblies are being built side by side at the Boeing Seattle plant during conversion to the latter bombers. In this photo B-29 wing flaps are shown in the foreground while beyond can be seen what remains of the long line of B-17 tail sections that formerly occupied this area. The Seattle plant is scheduled to be converted entirely to B-29 subassembly production by early next year, with final assembly at the Renton plant.

Why Are They Calling Styron THE Postwar Thermoplastic?

Reason enough—Styron (Dow Polystyrene) is changing plastic plans because its price, properties, and production influence nearly every choice.





There is already ample proof that plastic plans will start with Styron (Dow Polystyrene) in the postwar period. This great thermoplastic material has so many valuable properties and is capable of doing so many things that it has been in big demand for war duties. Naturally, production facilities have been expanded tremendously. As a result, Styron will probably be among the first plastics to be available for big jobs after the war. And this huge production means that the price will be exceedingly attractive—as it is today.

These factors, plus its well-known properties, all point to big uses for Styron. It will be in demand for precision moldings that must retain their shapes and details . . . for jewelry, trim and decoration for installations requiring immunity to acids and alkalies . . . for countless other decorative and industrial applications.

Keep your eye on Styron—it is the outstanding postwar plastic. Write for further details.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago
St. Louis • Houston • San Francisco • Los Angeles • Seattle

DOW PLASTICS INCLUDE

STYRON . . for fabricators producing moldings, extrusions, rod, sheet.

ETHOCEL . . for fabricators producing moldings, extrusions, coatings; available also as Ethocel Sheeting.

SARAN . . . for fabricators producing moldings, extrusions, pipe, tubing, sheet; available also as Saran Film.

STYRON

(DOW POLYSTYRENE)

From the only privately owned synthetic styrene plant with sufficient facilities to care for molders' postwar requirements.

DOW

CHEMICALS PLASTICS MAGNESIUM

INDISPENSABLE TO INDUSTRY AND VICTORY

New Products

New Device Dims Headlights Automatically

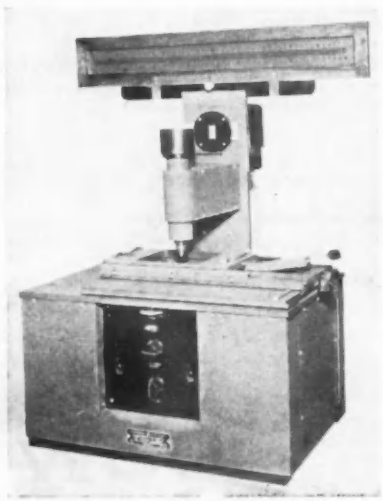
Arrow Safety Device Co., Mount Holly, N. J., has developed a device which takes the operation of headlight dimming out of the driver's hands entirely. When the headlights of an approaching car come within a predetermined distance, a special light-sensitive unit operates the dimmer automatically. Arrow plans to start making these automatic dimmers very shortly. All the preliminary work has been completed and production will begin just as soon as materials and plant-space are available.

Arrow automatic dimmer

Photometer for Measuring Light Transmission

A transmission photometer for measuring accurately the amount of light transmitted through very small areas of spectrographic plates, has been announced by the General Electric Company, Schenectady, N. Y. The new photometer is desirable for use wherever spectrographic analysis is employed, such as in the metal fields, and also for microcolorimetric and microchemical analyses and for measuring light transmission through solutions.

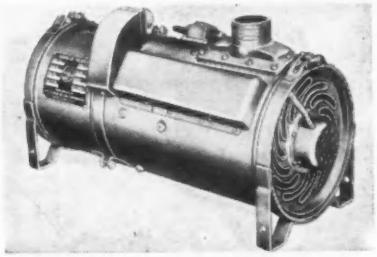
Requiring a constant power supply of 6 volts, a-c or d-c, with an approximate capacity of 30 amps., the photometer consists essentially of a light source, an optical system, a galvanometer, a light-sensitive cell, and a mechanical stage for accommodating the plate. This stage, which has a three-point, ball-bearing suspension, is movable in three directions. Control knobs mounted on the front of the instrument facilitate focal adjustment and control of the several diaphragms and filters in the optical system which govern the intensity of the light and heat reaching the light-sensitive cell and the plate.



G-E transmission photometer

Enclosed Combustion Vehicle Heater

The Herman Nelson Corporation, Moline, Ill., has brought out a gasoline burning heater known as its Model AT-1000 vehicle heater. Designed primarily for application to heating requirements in vehicles and other ground equipment, it serves equally well as a space heater for personnel comfort or as a preheater for warming up various types of machinery preparatory to operation in very cold weather.



Herman Nelson model AT-1000 vehicle heater

Although heat output is 20,000 B.t.u., the unit measures only 15 in. in length, the diameter of the outer shell being 6⅛ in. The weight is 17 lb. Powered by an integrally designed fan and electric motor, it is claimed that a new low-pressure principle of combustion results in a minimum of current drain on the vehicle's battery.

Installation requires a supply of fuel and a source of electricity. Operation is fully automatic, being remotely controlled by an on-off switch. It is pointed out that the heater fan can also be operated independently to provide unheated, ventilating air when desired.

Direct Line Swaged Hook

A new direct-line swaged hook is being manufactured by Poulsen & Nardon, Inc., Los Angles, Cal. They offer for the first time a hook that can be swaged to the cable. It is claimed that this new method of fastening is faster and safer than former methods.

Poulsen & Nardon hook

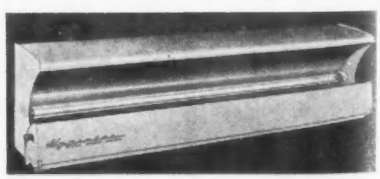
The hook has a straight shank and is made from alloy steel in a precision stamping operation that retains the full strength characteristics of the steel. It is so designed that the load is on a direct line from the cable. Tests are said to have shown its holding factor is in excess of the cable. P & N direct-line swaged hooks are available in sizes for 3/16-in. to 1-in. cable.

Improved Unit for Air Disinfection

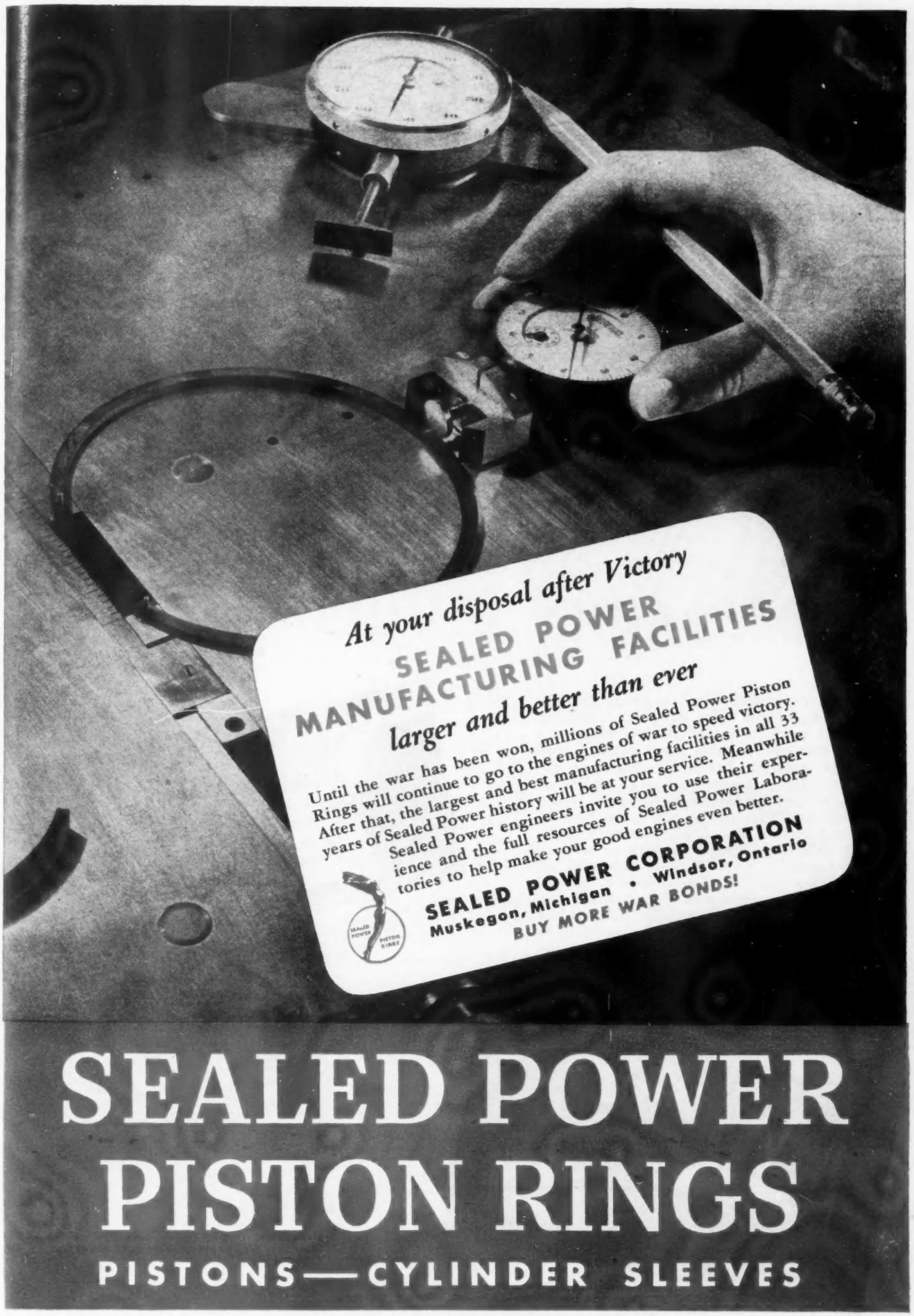
American Sterilizer Company, Erie, Pa., has recently introduced a new model "Hygeaire" unit for air disinfection. It differs from the original model in its shape and general appearance—the result of its having been streamlined and made more attractive to the eye by a new design.

This unit of "Hygeaire" system employs a G. E. germicidal tube to project intensified ultraviolet rays across living or working areas above eye level. A scientifically designed reflector provides both optimum intensity

(*Turn to page* 106, *please*)

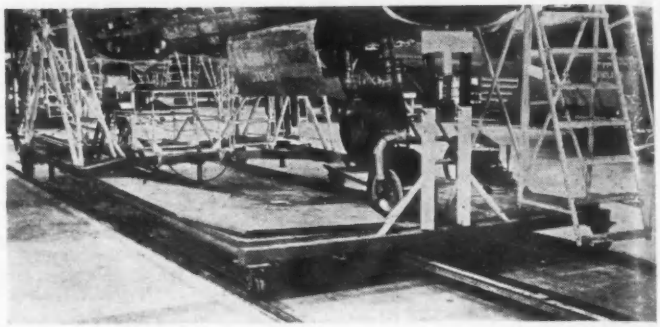


Hygeaire air disinfection unit


At your disposal after Victory
SEALED POWER
MANUFACTURING FACILITIES
larger and better than ever
Until the war has been won, millions of Sealed Power Piston Rings will continue to go to the engines of war to speed victory. After that, the largest and best manufacturing facilities in all 33 years of Sealed Power history will be at your service. Meanwhile Sealed Power engineers invite you to use their experience and the full resources of Sealed Power Laboratories to help make your good engines even better.
SEALED POWER CORPORATION
Muskegon, Michigan • Windsor, Ontario
BUY MORE WAR BONDS!

SEALED POWER PISTON RINGS

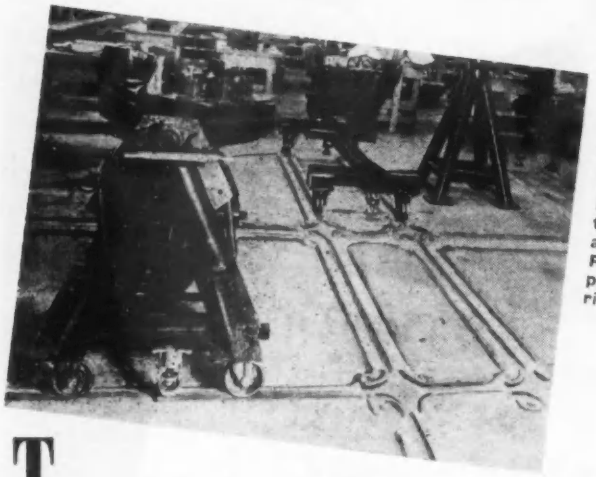
PISTONS — CYLINDER SLEEVES



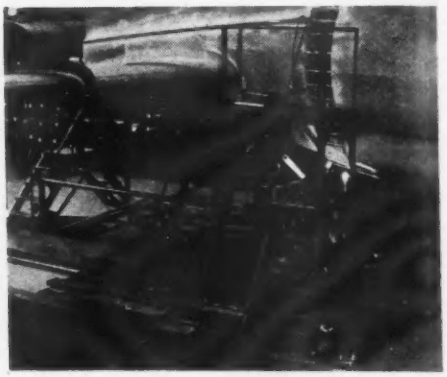
B-25 Mitchell bomber moves down the final assembly bay on grooved wheels and angle track in North American's Kansas City Division. Turntable and crossover switches are incorporated in the installations at the various factories

Production Lines

ROLL on GROOVED WHEELS



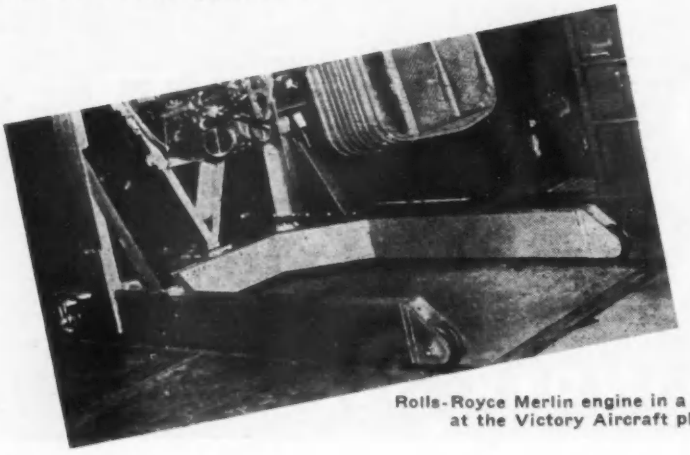
Curtiss Helldiver bridge frame and drag truss drill jigs equipped with grooved-wheel casters at the Canadian Car and Foundry Co. Note interesting track layout and transfer points. Position locks hold portable equipment rigid for drilling operations.



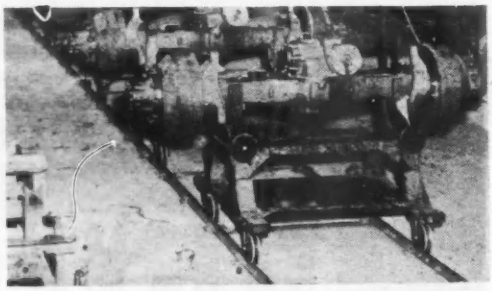
Tail section of a Curtiss C-46 Commando in the secondary splice fixture for joining it to the main fuselage section. The casters have grooved wheels.

THE use of casters with vee-grooved wheels rolling on angle iron track has been so successful in war production that current interest of postwar planners in this comparatively new method of materials handling indicates it will be incorporated in assembly lines at many factories when they are reconverted to make peacetime products. This system, which has been installed at most of the aircraft manufacturing plants and at some Detroit factories of automobile companies, is claimed to offer several advantages, most important of which are that the angle iron track is economical to install and permits quick changes in production line layouts. In addition this system provides easy mobility and the grooved wheels also can be rolled in direct contact with the floor. A few installations are shown on this page to give a general idea of its extensive application.

For this landing barge, a combination angle iron and flat rail were installed to permit handling on curves.



Rolls-Royce Merlin engine in a cantilever trolley jig at the Victory Aircraft plant in Canada.



Production line of heavy duty truck axles at the Madison, Ill., plant of Standard Steel Spring Co.

LIQUID PACKAGING
for Aircraft Parts

A complete line of rust and corrosion preventive compounds is manufactured by R. M. Hollingshead Corporation, a major supplier for Army and Navy aircraft. There are WHIZ compounds—conforming fully to Government specifications—for the protection of internal and external surfaces.

Applied to plane parts and weapons by spraying, swabbing, or dipping—depending on type—this "liquid packaging" eliminates the risk of rust and corrosion from factory to battle-line . . . is easily, quickly removed —*if* removal is required.

Your inquiries about these protective compounds will receive prompt attention. Our engineers are ready to work with your engineers in designing special chemical products to meet your particular needs. *R. M. Hollingshead Corporation, Camden, N. J.; Toronto, Canada.*

★

ALSO MAKERS OF WHIZ HYDRAULIC FLUIDS, COMPOUNDED LUBRICANTS, LUBRICATING OILS, AND CLEANING COMPOUNDS FOR AIRCRAFT.

WHIZ RUST PREVENTIVE COMPOUNDS
(Thin film, polar type)

WHIZ AIRCRAFT PRESERVATIVE COMPOUND
(Paralketone type)

WHIZ RUST PREVENTIVE COMPOUND
(Paralketone type)

WHIZ CORROSION PREVENTIVE COMPOUND
(For aircraft engines and parts)

AND OTHER SPECIAL COMPOUNDS.

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LEADER IN MAINTENANCE PRODUCTS

Whiz

BUY MORE WAR BONDS AND STAMPS NOW

Full Capacity of Automotive Industry Needed for War Items

Instead of Tapering Off, Production Requirements in December Are Greater than for Same Month a Year Ago

With the unexpected and tenacious resistance of the German army in Western Europe prolonging the conflict there many months longer than had been anticipated by even the highest military officers, any immediate reconversion hopes that automobile makers had entertained in the victory-flushed days of mid-autumn have gone glimmering. The plain, bald truth of the matter is that instead of tapering off, war production in general is on the increase. This does not apply to all military items, of course, but the recent impassioned, almost panicky, pleas by military and governmental officials for more and more output of certain critical war items indicate that the full productive capacities of the automobile industry will be needed for some time. J. A. Krug, WPB chairman, has stated that production requirements in December are $5.7 billion, $100 million more than for the same month a year ago, the highest point reached to date. He added that although this figure represents what it needed, WPB frankly does not expect that the goal will be reached. About 60 per cent of the scheduled programs are being met or exceeded currently, and about 40 per cent are lagging, chiefly guns, aircraft, ammunition, combat vehicles and trucks, and communications and radar equipment.

Further evidence that reconversion plans have been shelved by the Government is seen in the 90-day moratorium slapped on authorization of consumer goods production in 125 labor tight cities, including Detroit. Krug has stated that the scope of the armament program now being contemplated may even hold back reconversion for some time after the fall of Germany. In view of the unprecedented demands for military goods in both Europe and the Pacific, WPB probably will have to modify its previous plan for giving industry a comparatively free hand after V-E day, he said. Tentative contract cancellations submitted by the Army are substantially lower than the 46 per cent estimated last summer. If present estimates of military needs hold, according to Krug, the automobile industry will have to be placed under production ceilings consistent with manpower and materials available, and the number of orders which WPB previously had salted to be revoked automatically on V-E day would be reduced. Also, the construction industry, which will play a large part in providing new facilities for peacetime manufacturing, would continue to be held under strict control.

The ammunition program, once considered so far advanced that many plants were closed down, suddenly has become of major importance. At first, the cry was for heavy artillery ammunition when it was found that military requirements were eating into reserves that had been scheduled for use next year. Then it became increasingly apparent that small arms ammunition is being expended far out of proportion to what had been anticipated and the dip into reserves has become a matter of alarm. And finally, mortar ammunition now is discovered to be critical and a program of expanded production is under way.

At the moment, the small arms ammunition program is being pressed the most vigorously. WPB is working to more than double production, particularly on 0.30 caliber. To accomplish this goal, employment must be doubled,

(*Turn to page* 58, *please*)

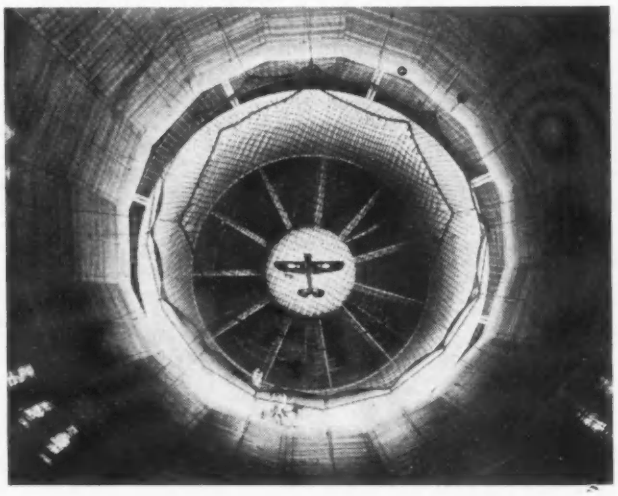
Metal Industry Little Affected By Halting of Reconversion Plans

With Minor Exceptions, Output of Steel and Metal Products Remains Earmarked for Military Requirements

By W. C. Hirsch

Aside from serving as a fresh reminder that flexibility of production continues to be the outstanding need in the present phase of the war in Europe, metal industry activities have been little affected by the widely publicized "whoas" to the strictly tentative plans for gradual reconversion. With the minor exception of what insignificent tonnages for civilian uses WPB has previously sanctioned, the country's entire output of steel and metal products remains earmarked for military requirements, and it is felt that the increased and imperative need of small arms ammunition and mortar shells has been permitted to put the picture of available materials somewhat out of focus. Steel producers as well as primary non-ferrous metal marketers point to the War Manpower Commission's statement that 60,000 workers are needed in a dozen small arms ammunition plants and 9000 in heavy artillery shell plants as a fair diagnosis of the principal cause of the output shortage. Much of the pressure of the shell program is concentrated in the Pittsburgh steel mill area, and the difficulties encountered in spreading it

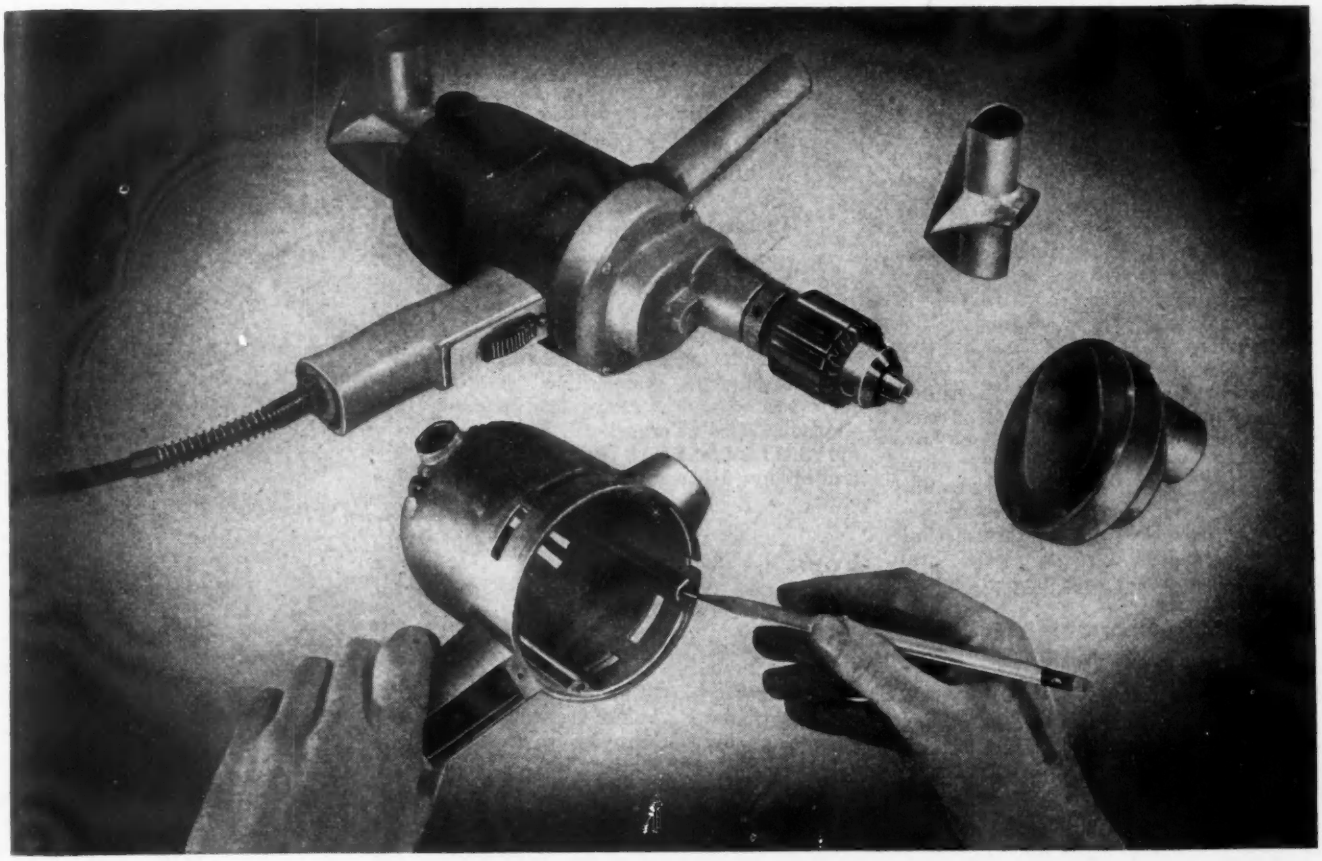
New Vertical Wind Tunnel



Exact scale models of newly designed AAF planes are launched into the upward airstream of the Air Technical Service Command's vertical wind tunnel at Wright Field, Ohio. Looking from the base of the tunnel, this illustration shows a free-flying model plane and the net into which it falls at the completion of the test.

COMPLEXITY!

—59% LESS LABOR REQUIRED THRU THE USE OF 3 ZINC ALLOY DIE CASTINGS IN THIS DRILL



Zinc alloy die castings are solving many of today's labor shortage problems. For example, by redesigning this electric drill to utilize 3 zinc alloy die castings, a saving of 59% in machining labor was effected over the former material and method of manufacture. In dollars and cents, the overall cost of these 3 parts was reduced 46%—a major contribution in producing the lowest priced *quality* ½" electric drill now on the market.

Complexity of design presents the opportunity for these labor and cost savings. Consider, for instance, that the assembly elements are now integrally cast in the one-piece combined motor housing and handle (foreground). Imagine the number of operations which would be required to turn out the equivalent of this part by any other method of production!

Economy of production is only one of the reasons why die castings of zinc alloy are the most widely used under normal conditions. *Every die casting company is equipped to make zinc alloy die castings,* and will be glad to tell you about their many physical advantages—or write to The New Jersey Zinc Company, 160 Front Street, New York 7, New York.

ZINC

FOR DIE CASTING ALLOYS

The Research was done, the Alloys were developed, and most Die Castings are specified with

HORSE HEAD SPECIAL (99.99+% Uniform Quality) ZINC

over a wider area stem from the products set-up which the war has engendered.

There has been a tapering-off in the pressure on steel plate output and, unless the war in the Pacific radically changes conditions, the tempo of plate mill activity is expected to slow down progressively from now on. But the facilities thus added are of little help in expediting the shell steel program, in the carrying out of which altogether different types of rolling mills are required. Much of the success of an individual steel company, even in normal times, depends on allocating to each of its products that part of capacity and raw steel supply that will result in profitable all-around operation. The slightest dislocation resulting from flaws in the products-mix is likely to prove costly, and to keep this products-mix in war time at levels that will yield the greatest possible production of what is urgently needed at a particular stage of the hostilities is a herculean task. The problem of 1945 steel prices as the result of the War Labor Board's recent increase of wage scales continues to occupy the minds of steel producers as well as of steel consumers. Recent developments have increased speculative activity in steel scrap with some mills paying premiums to attract shipments from more distant sources of supply. Transactions at ceiling prices, a rarity in the scrap market for some time, have been numerous of late.

Progress is reported in preparations for the cessation of all activity in Government-owned magnesium plants, military uses of the metal having decreased sharply and a considerable safety reserve having been built up. WPB has recently issued warnings that minor changes in cadmium regulations must not be interpreted as denoting relaxation of controls, the metal still being considered in critically light supply.

CALENDAR

Conventions and Meetings

SAE Annual Meeting, Detroit — Jan. 8-12

Natl. Automobile Dealer Annual Convention, Chicago — Jan. 29-31

Automotive Electric Assoc., Chicago — Feb. 5-12

Motor & Equipment Wholesalers Assoc., Annual Meeting, Chicago — Feb. 26-28

Amer. Soc. for Testing Materials, Pittsburgh — Feb. 28

SAE Aeronautic Meeting, New York — April 4-6

American Foundrymen's Assoc., Detroit — April 30-May 4

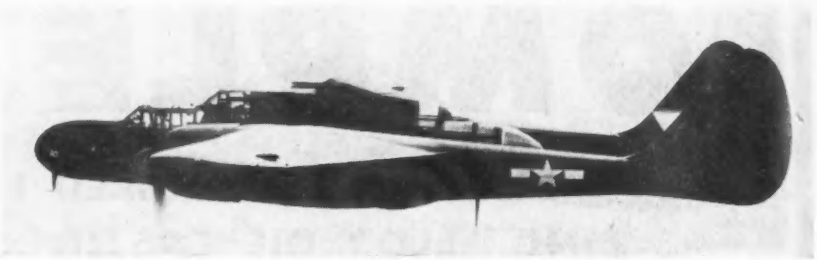
SAE Transportation and Maintenance Meeting, Pittsburgh — May 2-3

Pan - American Aircraft Exposition, Dallas, Texas — May 20-27

SAE War Materiel Meeting, Detroit — June 4-6

American Society for Testing Materials, Annual Meeting, Buffalo — June 18-22

SAE Tractor Meeting, Milwaukee — Sept. 12-13



Northrop Black Widow P-61 Night Fighter

Details of the Black Widow, heretofore secret, have been revealed by the War Department. With a wing span of 66 feet and an overall length of nearly 50 feet, the fighter is equal in size to a medium bomber. The top turret houses four .50 caliber machine guns. In addition to this armament, the plane carries 20-mm cannon, providing a combined fire-power which is said to be greater than that of any other fighter in the world.

Brunnier Heads AAA

H. J. Brunnier, a nationally known structural engineer who has devoted a great deal of time to highway transportation and motor club work, was unanimously elected president of the American Automobile Association at the forty-second annual convention held in Chicago. The meeting, which was the first held since Pearl Harbor, was attended by delegates from 644 motor clubs.

Ford's Vacation Bonus Plan for Veterans

Veterans of World War II who have returned to work at the Ford Motor Co. will receive a total of $80,000 under the company's bonus vacation plan which has been approved by the regional WLB. With more than 43,000 men in the armed services, the company expects to expend approximately $3 million in vacation pay under the program by the time all veterans have returned. The extra vacations will be granted to all veterans who have returned or who will return to work in any of the Ford plants within 60 days after discharge from service.

Any reinstated veteran whose length of service qualifies him for a vacation, and who returns to work after Dec. 1 and before June 1 of any year will be entitled to his full vacation with pay during the current vacation period. If he returns to work after June 1 and before Dec. 1, he will be given half his vacation with pay.

Cadillac Will Make Parts for Older Cars

WPB has authorized Cadillac Motor Car Division of General Motors to build a small number of non-functional parts for replacement on older model passenger cars. The action permits construction in 1945 of a limited number of body parts, mostly brackets, for holding sheet metal parts, if material can be obtained. Cadillac previously had received authorization to build a small number of hoods in 1945, also with the proviso that material is available.

1944 Monthly Production of Trucks and Truck Tractors*

1944	LIGHT Under 9000 lb. G.V.W. Civilian	Military	Total
January	.....	21,479	21,479
February	.....	21,095	21,095
March	.....	21,081	21,081
April	.....	19,481	19,481
May	.....	19,338	19,338
June	.....	20,830	20,830
July	.....	20,269	20,269
August	.....	23,441	23,441
September	.....	21,367	21,367
October	.....	18,534	18,534
Total—10 months	.....	206,915	206,915
	MEDIUM 9000 to 15,999 lb. G.V.W.		
	Civilian	**Military**	**Total**
January	1,985	12,806	14,791
February	1,798	9,940	11,738
March	3,317	8,303	11,620
April	6,245	6,649	12,894
May	7,310	7,007	14,317
June	9,319	6,625	15,944
July	8,582	6,031	14,613
August	10,248	5,746	15,994
September	10,034	6,300	16,334
October	9,429	6,144	15,573
Total—10 months	68,267	75,551	143,818
	HEAVY 16,000 lb. and over, G.V.W.		
	Civilian	**Military**	**Total**
January	543	21,783	22,326
February	968	21,870	22,838
March	1,311	22,347	23,658
April	1,906	21,438	23,344
May	1,988	21,277	23,265
June	2,607	21,805	24,412
July	2,661	23,997	26,658
August	2,263	26,847	29,110
September	2,243	25,098	27,341
October	3,641	26,375	30,016
Total—10 months	20,131	232,837	252,968
	TOTAL—ALL WEIGHTS		
	Civilian	**Military**	**Total**
January	2,528	56,068	58,596
February	2,766	52,905	55,671
March	4,628	51,731	56,359
April	8,151	47,568	55,719
May	9,298	47,622	56,920
June	11,926	49,260	61,186
July	11,243	50,297	61,540
August	12,511	56,034	68,545
September	12,277	52,765	65,042
October	13,070	51,053	64,123
Total—10 months	88,398	515,303	603,701

*—Automotive Division, WPB Data include jeeps, military ambulances and wheel-drive personnel carriers; half-tracks and armored cars are excluded.

To Select Heat Treating Data Quickly, Accurately

Men responsible for tools will find this new Heat Treating Guide issued by The Carpenter Steel Company a great convenience and time saver for themselves and the heat treating department. This is because it gives complete information on the heat treatment of all Carpenter Matched Tool Steels in handy, easy-to-use form.

You can tell at a glance for each steel: the type analysis, forging heat, normalizing heat, annealing treatment, hardening treatment, furnace atmosphere and recommended drawing range. In addition you can determine for each Matched Tool Steel the hardness for various drawing temperatures.

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Packard Aircraft Engine Testing Facilities

Construction contracts have been awarded and work begun on aircraft engine flight testing facilities which Packard Motor Car Co. will operate at the Willow Run Army Air Base in conjunction with the company's aircraft engine development project now in progress at its Toledo division, according to George T. Christopher, Packard president and general manager.

Under the $725,000 DPC grant for the work, new buildings will include a hangar large enough to house the largest bomber and several fighter planes, a three-story engineering laboratory complete with observation tower, and an attached power plant. Equipment will include engineering and modification shops for installation of engine mounts and auxiliary engine equipment, such as coolant and fuel systems; photographic facilities to record engine test performance and instrument readings, and radio devices for continuous contact between test pilots and flight test engineers on the ground. Engines will be developed and tested at the Toledo project and then installed in planes at Willow Run for flight testing. Until the new structures are completed, experimental work now under way will have temporary housing at Willow Run through cooperation of the Army and the Ford Motor Co.

Terming the new project more than a temporary undertaking, Christopher pointed out that the joint Toledo-Willow Run development is unique in that the Army Air Forces have authorized Packard to work directly with aircraft manufacturers in some instances in making installation improvements. Total commitments to Packard for engine developmental work and flight testing now are close to the $4 million mark.

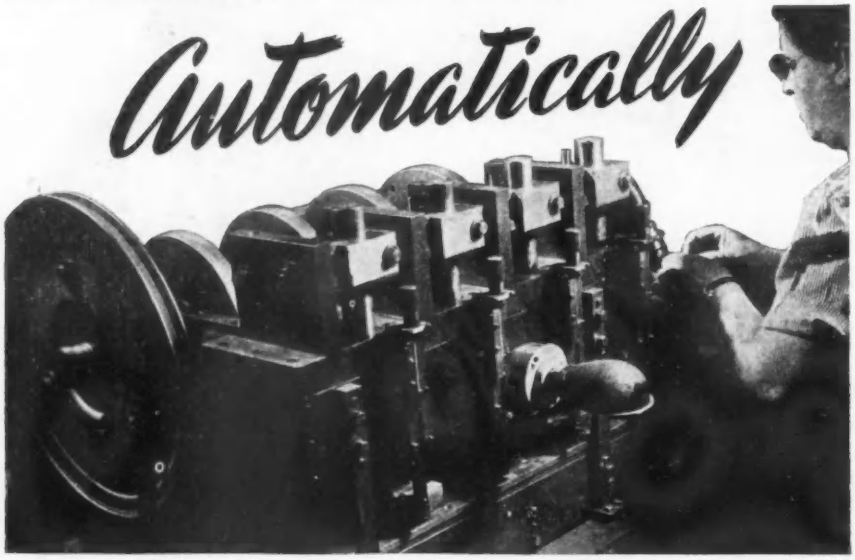
Huge Postwar Demand For Cars Predicted

About 17 million persons, representing 53 per cent of the number of automobile owners before the war, will be in the market for new cars by next July 1, according to William E. Holler, general manager of Chevrolet Division of General Motors. To put the nation back on a pre-Pearl Harbor basis, he states, will require production of five million cars a year for the first four years after the war.

Even more optimistic is the opinion of Joseph Frazer, chairman of the board of Graham-Paige Motors Corp., who predicts that the automobile industry will build 6½ million units in its first year of unrestricted production after the war and possibly 30 million cars in the first five years. He also estimates that there will be a market for 15 million automobiles and trucks immediately after the war, which will enable dealers to enjoy a series of "ten billion dollar years."

SETTING THE LENGTH TO CONTROL THE LOAD...

Automatically



Greater precision and closer control without sacrificing production remains a constant challenge to Accurate Engineers. It is the reason why many unusual machines like the one above have been developed and built by Accurate to help make *better springs faster.*

This automatic spring setting machine checks and sets compression springs to an *exact* length to closely control spring load. It saves time, labor, and reduces cost.

The quality and service you can expect from Accurate is the result of a combination of many things: special experience, "know how," ingenuity and interest in making better springs, quicker at lower cost. What are your spring and wire form problems?

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ARMY E NAVY

AWARDS

Names of winners of Army-Navy "E" awards in or allied with the automotive and aviation industries announced since the Dec. 1 issue of AUTOMOTIVE *and* AVIATION INDUSTRIES went to press:

CALUMET & HECLA CONSOLIDATED COPPER CO., Calumet, Mich.
CLEARING MACHINE CORP., Chicago, Ill.
THE FULTON FOUNDRY & MACHINE CO., Cleveland, O.
HARRISBURG STEEL CORP., Plants 1 and 2, Harrisburg, Pa.

Each of the selected firms will be privileged to fly the Army-Navy Pennant.

Obituary

Charles S. J. MacNeil, 34 chief engineer of Aeroproducts Division of General Motors Corporation, died of a heart attack November 18, after completing a forced landing in his cabin plane near Brazil, Indiana, after he became ill.

Air Power Through Piston Rings

McQUAY-NORRIS
ALTINIZED
PISTON RINGS

PISTONS...PINS...
HARDENED AND GROUND PARTS

More and more, the leading makers of aircraft motors are using McQuay-Norris precision parts. Our 34 years' experience in precision manufacture, our long and intensive work in metallurgy, heat treating, clinical research and laboratory experiment, enable us to turn out the sturdy, dependable parts demanded by modern aviation. Your inquiries are invited.

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Piston Rings
Oil Sealing Rings
Supercharger Rings
Carburetor Parts
Machined Aluminum Pistons
Piston Pins
Counterweight Cheek Pins
Machined Magnesium Parts
Cylinder Hold Down Nuts
Hardened and Ground Parts

PARTS FOR PROPELLER ASSEMBLY

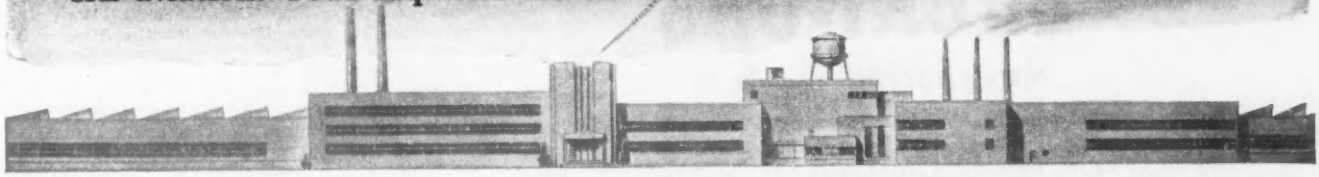
Machined Magnesium Parts
Piston Rings

EQUIPMENT FOR MAINTENANCE OF AIRCRAFT

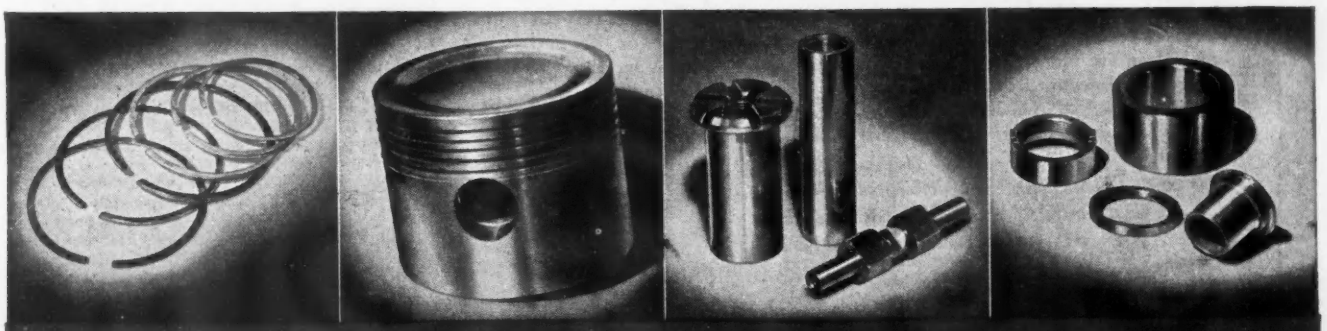
Pistons for Oxygen Compressor
Piston Rings for Oxygen Compressor
Pins for Oxygen Compressor
Pistons for Air Compressor
Pins for Air Compressor
Piston Rings for Air Compressor

LANDING GEAR PARTS

Machined Aluminum Pistons
Piston Rings
Hardened and Ground Parts



PRECISION WORKERS IN IRON, STEEL, ALUMINUM, BRONZE, MAGNESIUM



McQUAY-NORRIS MFG. CO. (AIRCRAFT DIVISION), ST. LOUIS, U. S. A.
CANADIAN PLANT, TORONTO, ONTARIO

PERSONALS

General Motors Corp. has announced the election of **Lewis W. Douglas** as a member of the board of directors.

The Goodyear Aircraft Corp. has announced the appointment of **Edward R. Burn** to the research and development staff. Before joining Goodyear, he was with Aeronca Aircraft Corp. as director of engineering and research.

Norge and Detroit Gear Aircraft Parts Divs., Borg-Warner Corp., has appointed **H. H. Whittingham** vice-president and manager of the latter unit and **Ira H. Reindel**, chief engineer for Norge, has been promoted to director of Norge engineering.

L. S. Stillwell, sales representative of The Western Automatic Machine Screw Co., has been named branch manager of the firm's Cleveland sales office. He replaces **W. W. Kimbrough**, who becomes branch manager of the Detroit office and warehouse.

Littlefuse, Inc., has announced the appointment of **Jack D. Hughes** as Eastern Div. Sales Manager, with headquarters in the newly opened offices of the company in New York City.

The appointment of **Donald B. Cooper** as a staff assistant in the Readjustment Service of the Aeronautical Chamber of Commerce has been announced.

Palmer A. Hewlett, representative for Consolidated Vultee Aircraft Corp., at Washington, has been appointed export sales director for the company. **Harvey C. Tafe**, service director in San Diego will replace Hewlett while **O. E. Mecham**, assistant service director, succeeds Tafe.

The appointment of **Ken Ellington** as manager of the New York office of the Aircraft Manufacturers Council of the Aeronautical Chamber of Commerce has been announced.

The Aro Equipment Corp. has announced the appointment of **A. C. Swygard** as sales manager of the Aro Lubricating Equipment Div. of Aro.

The National Screw & Mfg. Co. has announced the appointment of the following representatives: **Earl Benson**, for Minnesota, with headquarters at St. Paul. He succeeds **R. C. Johnson** of Minneapolis, recently retired after many years of service. For Wisconsin, on sales to manufacturers, Electrical and Steel Sales Co., Inc.

Donald W. Douglas, president of the Douglas Aircraft Co., was elected chairman of the board of governors of the Aeronautical Chamber of Commerce of America, Inc., and **E. E. Wilson**, vice chairman of United Aircraft Corp., was elected president of the chamber, at the annual meeting of the organization.

Edward S. Reddig, former assistant to the controller of The White Motor Co., has been elected controller. **Newton R. Collins**, former manager of the Truck Assembly Div., The White Motor Co., has been made director of the material control div.

J. A. Robinson has been named industrial manager of the Chicago branch of Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co. He succeeds **O. B. Wilson** who will be industrial manager of the company's New York branch.

Gould B. Martin has joined the public relations staff of Fairchild Engine and Airplane Corp. as publicity manager. For the past two years Mr. Martin has handled publicity for Hamilton Standard Propellers, a division of United Aircraft Corp.

Edward E. Helm, since 1928 district sales manager in Phila. for The Reliance Electric & Engineering Co., Cleveland, has been appointed general sales manager of the company. **Kenneth Lord** will succeed Mr. Helm as manager of the Phila. district.

William A. Leary, Treasurer-Comptroller of United States Plywood Corp., has been elected a director of the corporation.

John C. Straub, for the past thirteen years associated with the Research Laboratories Div. of General Motors Corp., has been appointed Research Engineer of American Foundry Equipment Co., Mishawaka, Ind.

W. J. Beatty has been named vice-president of foreign sales of ACF-Brill Motors Co., in which capacity he will resume concentration on foreign business and the development of postwar markets.

Appointment of **James C. Welsch** as private sales director for the Stinson Div. of Consolidated Vultee Aircraft Corp., has been announced.

Charles O. Guernsey has resigned his position as vice-president of The J. G. Brill Co., Philadelphia.

The Pittsburgh Plate Glass Co. has announced the appointment of **C. Robert Fay** as comptroller, succeeding **Stuart M. Campbell**, resigned.

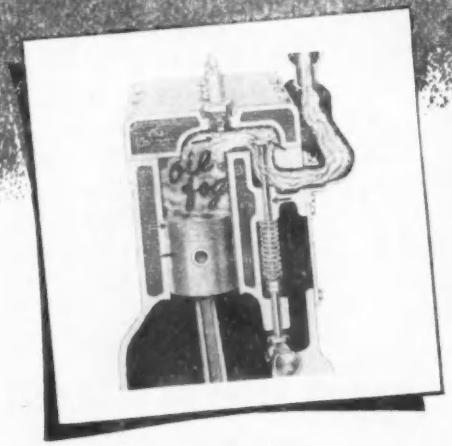
Charles W. Perelle, Houston and Los Angeles industrialist, has been named to the board of directors of Transcontinental and Western Air, Inc. Mr. Perelle is vice-president in charge of manufacturing at the Houston plant of Hughes Tool Co. and is general manager of the Hughes aircraft plant at Los Angeles.

Lieut. Col. Raymond W. Conroy, of the U. S. Marines Air Forces has been named president of Oil Purifier, Inc. **Harold G. Rice**, former manager of Pioneer Motor Bearing Co. has been named vice-president and general manager of plant production and **Virgil Valser** becomes chief consulting engineer and a member of the board of directors.

Dodge Div., Chrysler Corp., has announced four new regional managers. **Wilbur T. May**, New York regional manager; **Mark M. Whipple** has been promoted to Boston regional manager; **Leslie W. Neumann** has been promoted to St. Louis regional manager and **J. W. McLaughlin** has been appointed Cincinnati regional manager.

(*Turn to page 56, please*)

advise motor users:



Keep Valves, Guides, Upper Cylinder, Pistons, Rings

Oiled thru Carburetor

by treating your gasoline with

LUBRI-GAS

there's NOTHING else like it!

No mechanical system has ever been invented that assures constant, adequate lubrication of valves, guides, upper cylinder, pistons, rings. That is why sticky valves, burned and pitted valve seats, worn rings, and carbon and gum accumulations in upper cylinder are usually the first symptoms of motor trouble. Lubri-Gas Laboratories have developed an exclusive method of chemically processing 40 SAE lubricating oil, so that it enters the combustion chamber, through the carburetor, as an oil fog, and coats all upper cylinder parts with a film of clean oil. The results of this better lubrication are more power, more mileage per gallon, more pep, less wear and repair, freedom from carbon and gum and prevention of overheating and oil pumping. Now when it is so important to keep equipment in operation and out of the repair shop, LUBRI-GAS is indeed a God-send!

Send for Free Lubri-Gas File. Contains complete information about this modern motor fuel treatment.

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Cleans and Lubricates as It Powers the Motor

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YOU CAN BE SURE that the molded rubber gaskets and seals you order from Armstrong will have exactly the physical properties you require.

During the past 27 years, Armstrong has successfully developed thousands of natural and synthetic rubber formulas to meet tough conditions such as extreme pressure . . . severe mechanical strain . . . high or low temperatures. The compounding skill resulting from this long experience is your assurance of getting the right material for any sealing job.

You can be sure, too, that the parts will fit perfectly. For Armstrong makes a specialty of precision-molding—has the experience and facilities necessary for molding gaskets, packings, and seals to close tolerances.

In addition to many kinds of sealing materials, Armstrong supplies other specialized products to the automotive and aviation industries. (See list below.)

For technical details about any of these products, write Armstrong Cork Company, Industrial Division, 1512 Arch Street, Lancaster, Penna.

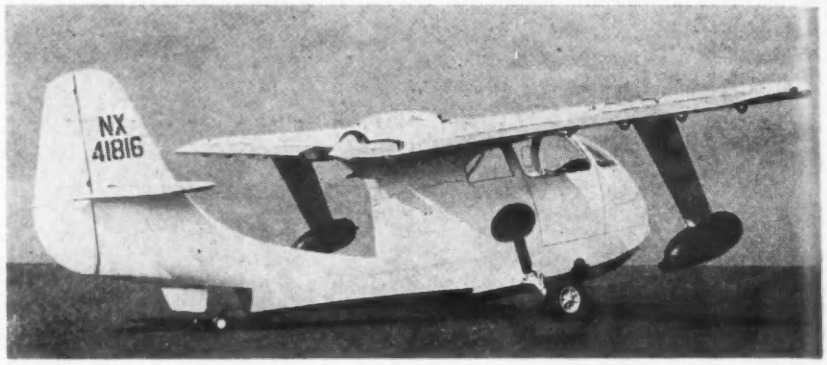
MATERIALS AND SPECIALTIES FOR AIRCRAFT AND AUTOMOTIVE UNITS

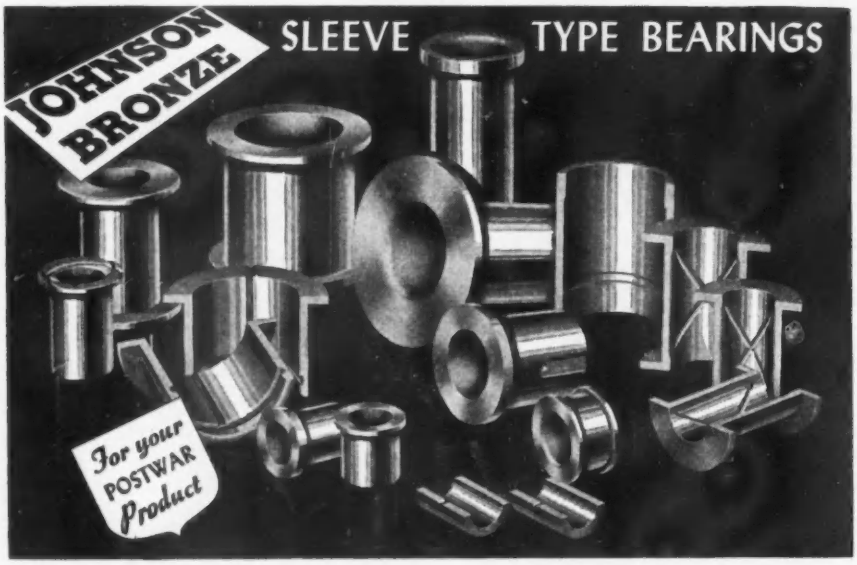
- **Gaskets, packings, seals,** piston cups, bushings, and valve seats—for gauges, fuel lines, meters, hydraulic systems, and other equipment
- **Composition roll goods,** with or without fabric back, plain or adhesive-coated—used as glazing strip, binding tape, cushion pads, anti-skid flooring, and gaskets
- **Tank strap cushions**
- **Sealing materials** for specialized aircraft equipment handling aromatic fuel
- **Felts** for vibration-damping and soundproofing
- **Wingwalk materials**
- **Resilient floorings**
- **Carburetor floats** and other fabricated natural or composition cork specialties

ARMSTRONG CORK COMPANY

Republic Thunderbolt Amphibian—A Postwar Preview

Although P-47 Thunderbolts are now coming off the assembly lines of Republic Aviation Corporation at full speed, plans are being made for post-victory production. Shown here is one of the first pictures of the tentatively designed Republic Thunderbolt Amphibian. At its present stage of development, the plane is an all-metal, high-wing amphibian, powered by a single 175-hp engine. It accommodates four passengers and is expected to sell for less than $4,000.





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● When you design your new product for tomorrow's market it will pay you to investigate the advisability of using CAST BRONZE bearings.

You gain several distinct advantages in cast bronze. In the first place few bearings deliver the smooth, quiet, efficient performance for so long a time as cast bronze. Properly designed and installed, they will usually outlast the motive unit in which they are used. The initial cost is comparatively low, they are easy to get and easy to replace.

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JOHNSON BRONZE
SLEEVE BEARING HEADQUARTERS
625 S. MILL STREET NEW CASTLE, PA.

Personals

(*Continued from page* 54)

T. Kelly Pierce has been made general manager of the Duramold Div. of Fairchild Engine and Airplane Corp.

C. E. Bleicher, who has been vice-president and general manager of the DeSoto Div. of Chrysler Corp. since 1937, has been made president and general manager of the division in complete charge of all operations. He succeeds Lt.-Col. Byron C. Foy, who has just returned to civilian life from overseas duty with the Air Service Command and who will resume his civilian duties as vice-president and director of Chrysler Corp. with offices in New York City.

Frank Skinner, who has been handling public relations for Pontiac Motor Div. of General Motors Corp., has returned to the staff of McManus, John & Adams, Detroit advertising firm and advertising counsel to Pontiac. He will be succeeded by **J. H. Nimmo,** of the Corporation's Detroit public relations staff.

William P. Michell has been appointed chief engineer of Mack Truck, Inc., according to L. C. Josephs, chief engineer. Michell, who recently returned from England where he had been serving in an advisory capacity on military truck transport, has been associated with Mack since 1923.

Appointment of **Frank Link** as assistant used vehicle merchandising manager has been announced by Studebaker Corp. He has had 20 years experience in wholesale, retail, and used car operations.

D. J. Vail, sales manager of Campbell, Wyant & Cannon Foundry Co. has been appointed to the Gray Iron Founders' Society committee on terms of sale and trade practice.

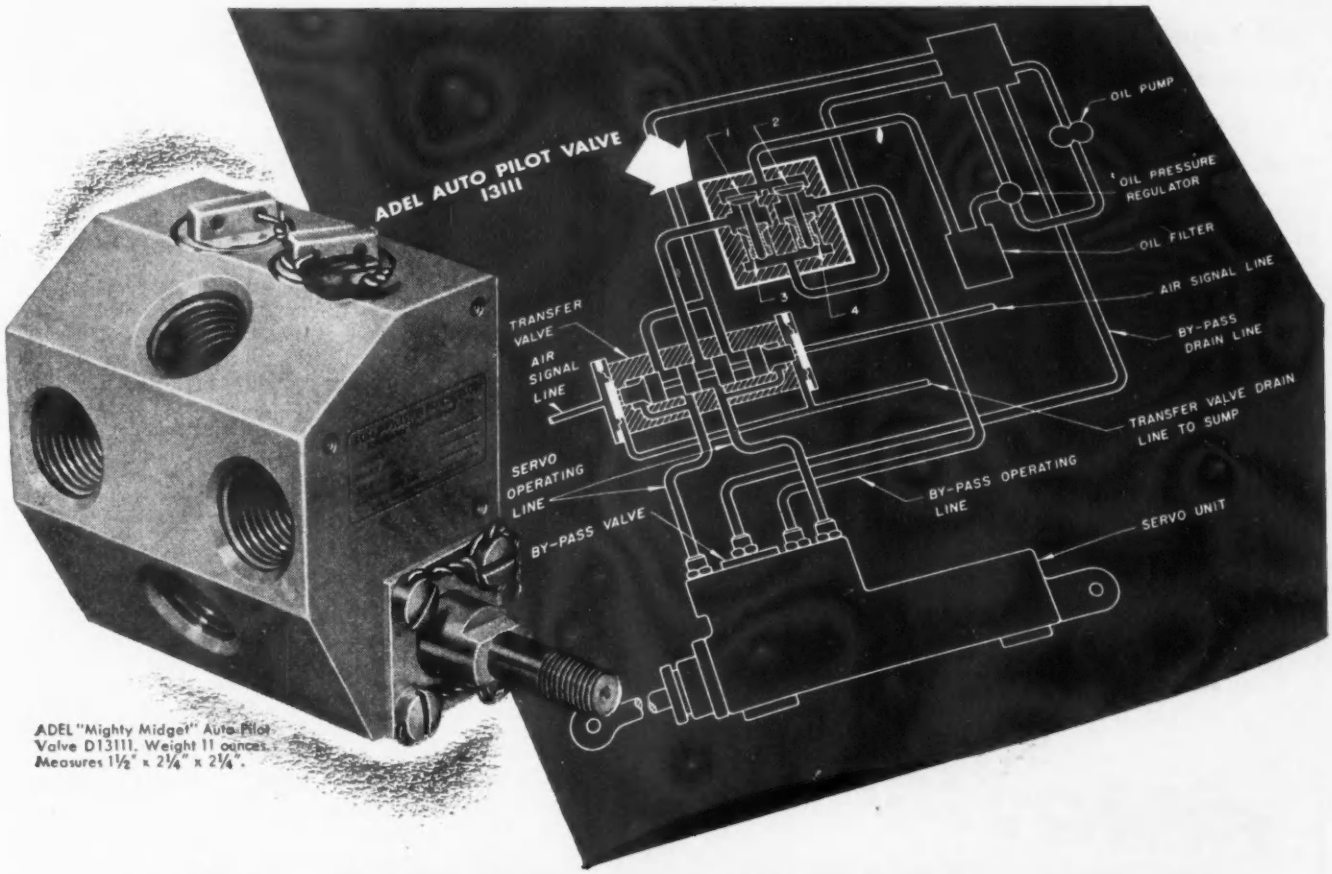
Harold L. Rowland has been named assistant to Roger M. Kyes, president of Harry Ferguson, Inc., Dearborn, Michigan.

Daniel H. Holmes, manager of the Weatherhead factory at Columbia City, Ind. for the past two years, has been appointed district sales manager of the New York territory, with headquarters in New York City.

Arch Warner has been elected president and general manager of Rockford Drilling Machine Div. of Borg-Warner Corp. Warner, who formerly was works manager of Mechanics Universal Joint Div. of the corporation, succeeds **E. C. Traner** who has retired from active management of the company to become chairman of its advisory board.

H. P. Brigham, for the past several years a vice president and account executive of Ross Roy, Inc., has joined R. L. Polk Co., Detroit, as head of the merchandising and creative department. He will supervise development and operation of an expanded creative and merchandising staff, and will direct creative activities on all Polk national accounts.

Appointment of **W. E. Fish** as assistant general sales manager of Chevrolet Motor Div. of General Motors Corp. has been announced by W. E. Holler, general sales manager. Fish, who has been manager of the central office truck department for 11 years, will have charge of the division's nationwide commercial and truck activities



ONE VALVE REPLACES TWO IN S IV GYRO-PILOT

Approval by Sperry Gyroscope Company of the ADEL "Mighty Midget" No. D 13111 for use in this internationally famous company's S IV Gyro-Pilots is unusual proof of quality and DEPENDABILITY. It replaces two plug valves on installations to date with following advantages: (1) Automatic sequence—no need of manual operation of two plug valves in correct sequence. (2) Reduction of service trouble previously experienced from internal and external leakage. (3) Lower handle loads—15 in. lbs. max. at normal operating pressures.

Accepted for this installation by Bureau of Aeronautics, the unit is identical, except for camshaft, to ADEL "Mighty Midget" AN 6210 and similar to D 10150 which was granted Winterization Yellow Dot Approval. See ADEL for the answer to *your* control problems. Over 500,000 hydraulic, *HYdronic (hydraulic-electric) and *ISOdraulic units now in service—Land, Sea and Air thruout the globe.

For information, see the nearest office or write today.

*Trade Mark

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Full Capacity of Automotive Industry

(*Continued from page* 48)

three closed plants reopened, and output stepped up in ten others. It is estimated that 62,000 workers will have to be added to the present 53,000 if production is to be doubled in the next four or five months. The automobile industry will be called on as usual to do its part in the expanded ammunition program. Willys-Overland, which closed out its shell program several months ago, will make cores for small ammunition in its foundry. Other companies which will take on new ammunition programs or continue with programs now in progress are the Pontiac, Chevrolet (at St. Louis), Oldsmobile, and Grand Rapids Stamping divisions of General Motors, McQuay-Norris, and Motor Wheel Corp. And although the copper supply at the moment is in fair shape, if it should become critical because of the great amount needed to make brass strip for small arms ammunition, Buick Div. of General Motors might conceivably be called on to go back into steel shell production as it did earlier in the war.

There is a conviction among many men in the industry that the "spot" authorization program, although of not any great extent as yet, may have gone too far in authorizing resumed production of certain peacetime goods. They say that manpower still is tight, despite localized program adjustments. Their contention is partially borne out by reports that some spot authorizations may be revoked and the companies asked to take on war work again. The Army has come through with two moves calculated to speed critical war production programs. The first calls for the release of about 1000 men for work in foundries and forge shops, which have been behind schedule consistently. These men, all over 30, will be hired directly by the foundry upon their discharge. It is anticipated that the Navy also will release some men for war work. The second move, intended to shunt war contracts into non-critical labor areas and into plants of small manufacturers, regardless of where located, authorizes payment of a premium up to 15 per cent above the lowest price bid by manufacturers in areas of critical labor shortage.

The Ford Motor Co. has received a new $28 million contract calling for an increase in production of the standard V-8, 500-hp. tank engine, which it has been producing for more than two years, and including the first large order for a new type tank engine.

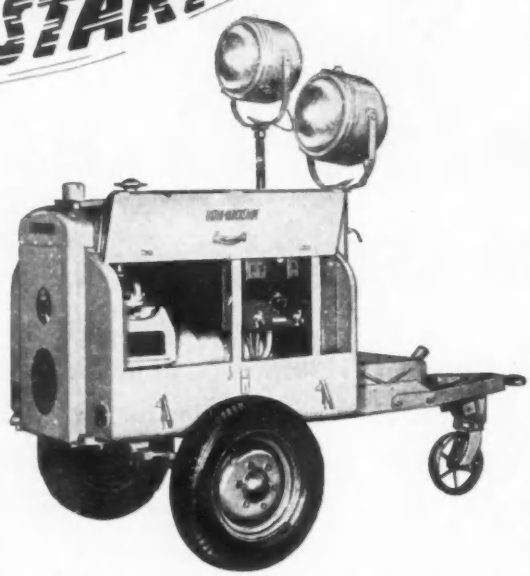
Under a new schedule from the Army, production of B-24 bombers at the Ford Willow Run bomber plant will be stepped up to slightly under the bomber-an-hour pace in effect last summer before output was cut back. The new contract calls for steady production at that rate until at least next spring, and will require employment of several hundred more workers. The revised quota also probably will mean that the plant will resume Saturday work extending the work week from 45 hours to 54.

Although the heavy truck program nationally is running far behind schedule, the Federal Motor Truck Co. currently is meeting its schedule of heavy duty Army trucks. The company has been turning out trucks for the military since 1940, and at present is building units for both the Army and for essential civilian use on the same line.

Details released on the military truck being built by Dodge Div. of Chrysler Corp. for the Chinese government indicate that it compares in a general way with the three-ton unit which the division made for domestic hauling before the war. Although listed at 20,000 lbs. gross weight (loaded) the truck is expected to carry emergency overloads frequently because of conditions prevailing in China. Horsepower and speed have not been revealed, but both are said to be high. Other features include: 170-in. wheelbase, tri-metal aircraft-type bearings, down-draft carburetor, airplane-type shock absorbers, rugged steering gear, double reduction axle, and an auxiliary overflow tank from the radiator to provide extra

NITE HAWK

AERO-STARTER



ALL WEATHER PLANE STARTER

Here is dependable starting power in coldest weather. The Nite - Hawk Aero - Starter provides ample, continuous power for starting airplane engines, including those in heavy bombers, at any temperature.

A portable engine-driven power plant, it operates independently of other power sources. Also furnishes power for testing turrets, circuits and wiring, landing gear, etc. Equipped with floodlights for night operations. Air compressor attachment for inflating tires available. Investigate!

Write for Bulletin NH12A

NITE HAWK Lister-Blackstone INCORPORATED 1706 SO. 68TH ST., MILWAUKEE 14, WIS.

MFRS. OF PORTABLE NITE-HAWK AERO-STARTERS, SEARCHLIGHT AND FLOODLIGHT UNITS

ALSO DIESEL ENGINES AND DIESEL-ELECTRIC POWER PLANTS

Meet Your Delivery Requirements

With

Jessop STAINLESS STEELS

Centerless Grinding Stainless Bars

★ Your requirements for stainless steel can be readily met when you specify—"Jessop Stainless." With the situation growing less critical for this important metal, and because of the installation of additional processing equipment, Jessop is better able to meet your needs for faster deliveries. Orders for both standard analyses and special analyses are given the same prompt attention.

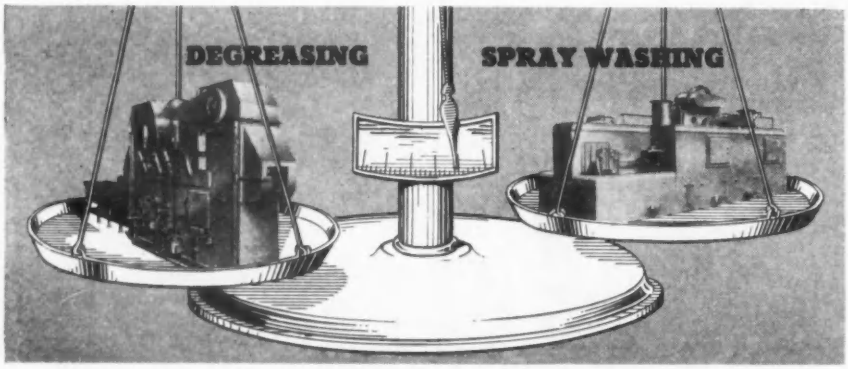
In addition, Jessop metallurgists are prepared to advise you not only on chemical properties but also on machinability and other characteristics in selecting the best type of stainless steel for your applications. Jessop Stainless bars are available hot rolled, centerless ground and cold drawn. When stainless sheets and plates are required, Jessop service will assure fast delivery.

WRITE FOR FURTHER INFORMATION

JESSOP STEEL COMPANY

HEAD OFFICE AND WORKS: WASHINGTON, PENNA.

Established 1901



DETREX MEN CAN HELP YOU

Weigh Their Particular Advantages

For Your Production

If you are considering the installation in your plant of solvent-vapor degreasing machines or washers for alkali, spirits or emulsion cleaning, a Detrex man can aid you in making your decision as to the type of equipment best suited to your needs.

Detrex is the one manufacturing source where you can go for unbiased and authoritative opinions on the relative merits of various types of metal cleaning machines and chemicals. For, not only does Detrex produce degreasers, washers and processing machines, but also supplies Perm-A-Clor and Triad degreasing solvents, and Triad Alkali Cleaning Compounds for washers, electric cleaning and soak tanks. Each has its application, and your specific requirements are our guide.

Detrex has branch offices in principal cities. Write for the name of our engineer in your locality. He will be glad to consult with you without obligation.

KEEP BUYING U. S. WAR BONDS

DETREX CORPORATION

13001 HILLVIEW AVE., DETROIT 27, MICHIGAN

cooling. Drive is through rear wheels only.

Continental Motors Corp. has received a $3.3 million facility contract through WPB, calling for alterations in the test house and installation of machinery and equipment in its present building to be used in connection with production of the Ford "GAA" tank engine. Because the engine is of different size, shape, and horsepower from engines now being built, new equipment costing $3,252,981 and including presses, tanks, ovens, and monorails will be required. Building alterations will approximate $123,000.

By adapting automobile assembly line manufacturing techniques to aircraft engine production, Chevrolet Div. of General Motors now is turning out two sizes and three models of Pratt & Whitney engines on a single assembly line. Prime factors that make the system work are organized and systematic scheduling and control of materials, adequate floor space, and use of a scheduling board. Application of a number control system also is important in routing parts and assemblies to the line in proper sequence to fit each engine. Engines being built are a new, big 18-cyl., 2000-hp. type and a smaller, 14-cyl., 1200-hp. engine.

PUBLICATIONS

A new illustrated 50-page **milling machine tools and accessories catalog,** C10, has been issued by the Kearney and Trecker Products Corp. It gives complete listings and information on arbors, cutters, vises, high speed attachments and center scope for every standard milling machine. A feature of the catalog is its arrangement, which makes information easy to find. By giving comprehensive information and listings on all types of milling tools and accessories it provides a single source of reference and supply.*

Aircraft Screw Products Co., Inc., has issued two new bulletins. No. 240 describes **Heli-Coil Insert Kits** for field servicing, salvage and maintenance of stud and cap screw assemblies. Bulletin No. 260 describes two interesting maintenance and salvage operations in the shops of a prominent airline company and an engine manufacturer.*

Carboloy Company, Inc., has issued a new 20-page booklet, **Tips for Tube Mills on the Use of Carboloy Mandrels.** The booklet is illustrated with numerous blueprint type sketches, and gives complete information on the care of carbide mandrels.*

A 4-page folder, printed in color, illustrating the properties of the **cellulose plastics** family, has been issued by Hercules Powder Company's Cellulose Products Dept. It is designed for nontechnical, as well as technical readers, and illustrates the characteristics of a selection of end products made from cellulose acetate, ethyl cellulose and cellulose nitrate.*

Air Reduction has issued a new 12-page illustrated booklet, **Oxyacetylene Pipe Line Installations,** which gives a concise description of typical oxyacetylene pipe line plans for various size industrial plants. Details on pipe sizes, central depot location, station outlets, safety devices and other pertinent data are included. Schematic diagrams of piping layouts for typical plants are among the many interesting topics discussed.*

(*Turn to page 92, please*)

Partners with the Automotive and Aviation Industry from the start ☆☆☆

ENGINEERING B-W PRODUCTION

BORG-WARNER

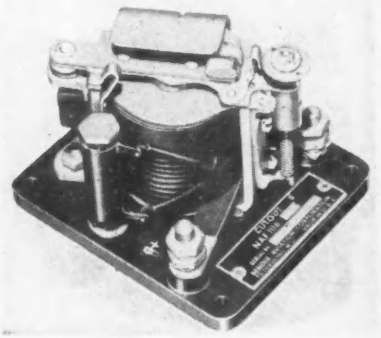
When peace returns, Borg-Warner will again make these and other products for the Automotive and Aviation Industries—

BRAKE INTENSIFIERS • BRAKE VALVES • CARBURETORS • CATALYSTS • CLUTCHES • CLUTCH ACTUATORS • CLUTCH DISCS • CLUTCH SPRINGS • DEBOOSTER VALVES • DIALS • ENGINE PARTS • FLAT SPRINGS AND STAMPINGS • FUEL, VACUUM, GEAR AND HYDRAULIC PUMPS • FLUID COUPLINGS • • GEARS • HEATER ELEMENTS • HEATERS • HYDRAULIC CONTROL VALVES • OVERDRIVE AND SYNCHRONIZER UNITS • PROPELLER GEARS • RADIATORS • • REPLACEMENT PARTS • RUBBER TO METAL ADHESIVES • STABILIZERS • STEEL STAMPINGS • SUPERCHARGERS • TIMING CHAINS AND SPROCKETS • TRANSMISSIONS • UNIVERSAL JOINTS • VALVE SPRINGS • VALVES AND ACCESSORIES • WHEEL DISCS

New Products for Aircraft

Reverse Current Cutouts

Eclipse reverse current cutouts, made by the Eclipse-Pioneer Division of Bendix Aviation Corp., Teterboro, N. J., are designed to prevent the reverse flow of current to generators in aircraft power systems, utilizing batteries and generators as a power source. Properly installed in the aircraft power supply system, they provide a compact, lightweight means of automatically disconnecting generators from electrical systems when generator voltage drops below system voltage. The reverse current cutouts also operate as generator automatic main switches. Eclipse reverse current cutouts operate satisfactorily in any mounting position when adjusted in that position. Changes in cutout temperature have a minimum effect on their operation. The armature leads on Types 352 and 665 are shielded to prevent change in cutout setting through handling. Silver alloy contacts have long life and low voltage drop and the adjustment knob is conveniently accessible and automatically locked.

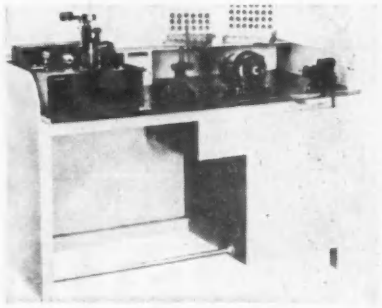


Eclipse reverse current cutout

Two New Testing Devices

Airplane Manufacturing & Supply Corp., North Hollywood, Cal., has brought out a spark plug service stand for servicing and testing aviation spark plugs, and a test unit for testing clutch settings on starters used with engines up to 100 cu. in. displacement.

The AMSCO spark plug service bench is provided with a storage and drying space that will handle 350 spark plugs. This compartment will maintain a temperature of 150F. The bench is made in two models, depending on the type of equipment desired. Model A660W is equipped with a BG M-591 Wheatstone bridge type spark plug tester with bomb and regulator, one electrode adjusting tool, a ¼-hp electric motor for cleaning mica type spark plugs and a heavy duty vise. Model A660M has a BG M-519 test bomb with magneto and three-point gap panel, an electrode adjusting tool, a ¼-hp electric motor and a heavy duty vise.



AMSCO A660W spark plug test bench

The aircraft engine starter tester Model A760 consists of a one-piece casting, mounted on a 7-in. steel channel. To hold the starter to be tested,

PUT THE BUELL AIR COMPRESSOR IN YOUR POST WAR PICTURE!

Why not investigate the possibilities of the Buell Air Compressor for your Post War Production. The many ways in which it can serve your needs may surprise you. Thousands are in active service in Canadian fighter and bomber planes. Their precision workmanship, demanded in aviation products, assures long service without frequent parts replacement. Designed for compactness and light weight, they will fit into surprisingly close quarters. Put air to work! It is clean, powerful and reliable. Write us, advising all details as to volume and pressure, etc., and our engineers will gladly aid you in solving your problem. We specialize in small, high speed compressors of the highest quality.

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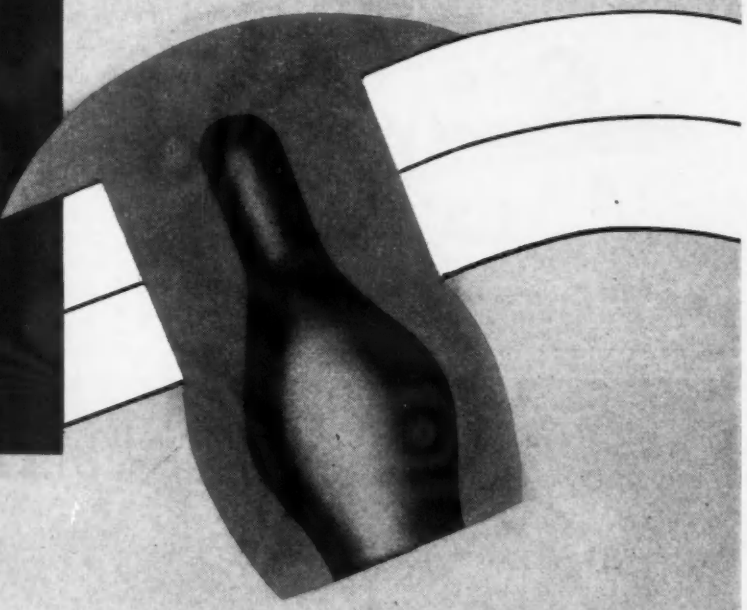
DU PONT EXPLOSIVE RIVETS



will have many postwar applications

DURING the past three years aircraft builders have proved the value of Du Pont Explosive Rivets by using them to speed up the construction of many thousands of the planes they've built.

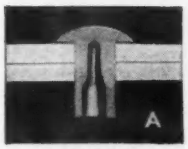
In days to come, Explosive Rivets will similarly serve many peacetime industries . . . by speeding up the job of blind riveting and making it easy to work in places that are hard to get at.

Explosive Rivets are easy to use. Only two simple steps are necessary to install them: 1. Insert the Rivets in the holes. 2. Apply the heated iron to the head of each Rivet and in 1½ to 2 seconds it is set. Expansion of the entire shank of an *Improved* Explosive Rivet completely fills the hole even when it is slightly oversize. And a barrel-shaped head on the blind end locks the Rivet securely in place.

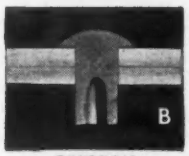
This simplified method of blind riveting speeds up the work, reduces costs and results in a better job. So check into its possibilities NOW! If you are in the automotive, air conditioning, refrigeration, radio, sheet metal fabrication or other industry in which riveting is done . . . write for "High Speed Blind Riveting with Du Pont Explosive Rivets." This manual contains complete information on Explosive Rivets, their applications and uses.

E. I. du Pont de Nemours & Co. (Inc.), Explosives Department, Wilmington, Delaware.

DU PONT
REG. U.S. PAT. OFF.



IMPROVED



ORIGINAL

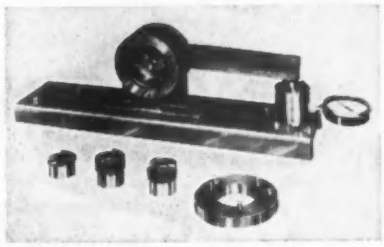
IMPROVED EXPLOSIVE RIVETS

Compare A, the *Improved* Explosive Rivet, with B, the original design. Note extended cavity of the *Improved* Rivet. When expanded, the Rivet shank completely fills the hole . . . forms a strong, tight joint.

DU PONT *IMPROVED* EXPLOSIVE RIVETS

The only one-piece blind rivet

a 5-in. diameter mounting plate and one 3-tooth starter jaw with torque arm and piston and gauge assembly are furnished as standard equipment.



Model A760 aircraft engine starter tester

The foot pounds of torque are registered on the torque gauge which is connected to the piston assembly.

Power Rheostats for Aircraft

Two new approved power rheostats for aircraft are announced by The Ohmite Manufacturing Company, Chicago. These units are made in accordance with the latest Army-Navy Aeronautical Specifications AN-R-14a. (Drawing 3155.)

These new approved Ohmite AN aircraft rheostats are light in weight—lighter than the allowable weight specified. They meet the salt spray corrosion test, and other critical tests—and operate satisfactorily in the temperature range from —55C (—67F) to +70C (+158F).

Ohmite power rheostat

Two sizes are available, Ohmite Model "J" 50-watt and Model "H" 25-watt. They are linear or taper wound, in various resistances, with "off" position, as required.

Baldwin Strain Gage

The Baldwin Locomotive Works, Philadelphia, Pa., is introducing a new strain gage said to be capable of measuring to the millionth of an inch the amount of vibration in a piece of metal or an airplane wing in flight. The gage is applied with cement to whatever is to be tested, and measures pressures and forces of all kinds, recording vibrations of 30,000 cps when hooked up with electronically-operated recording instruments.

Peugeot Regains Possession of Factory

Peugeot, one of the big three in the French automobile industry, has regained possession of its factory at Sochaux, near the Swiss frontier, with a loss estimated at $16 million to $20 million. The Germans evacuated Sochaux when the American armies were making their lightning drive across France, but when this advance was halted twelve miles west of the town, they came back and started looting on a big scale. Before the town was definitely captured by French and American troops, the buildings suffered some damage from shell fire, principally to the roofs.

The greatest loss came, however, from the systematic removal of everything which could be carried away. Not an ounce of raw material of any kind, and no finished parts, were left behind. Particular attention was paid by the German removal gangs to the forges, presses and the foundry. One-third of the machine tools were taken away. Peugeot engineers followed up with the Allied armies and were able to recover some of the stolen equipment in Alsace, where it had been held up owing to difficulties in getting it across the Rhine. Peugeot directors state that they are going to rebuild as rapidly as possible, to recover as much of their plant as possible from Germany and to make purchases abroad as soon as that can be done. Every effort will be made to get into production at the earliest possible date.

Bearings
for
Present or
Post-war
Plans
Let us work out with your engineers the design, application and service of any type anti-friction bearing on which you may need specialized advice. Our research into the operation and performance of bearings—their stress, load and service conditions—qualifies us to be helpful to you in governing your design of Ball and Roller bearings. Thirty-two years engineering experience in the making of high quality, smooth precision, heavy duty, special design and standard bearings over 100 MM. O.D.
Write or phone for new Catalog giving full particulars.
Equitable
EQUITABLE BEARING CO., Inc.
DEPT. AI
WALDEN, N. Y.

trace THIS FIGHTER'S RECORD BY HIS MEDALS!

"Captain Dag"

If there were decorations for industrial heroes, Mr. Dag would be a much be-ribboned gentleman. Perhaps we should call him 'Captain' Dag, because he commands so versatile a company of physical and chemical properties.

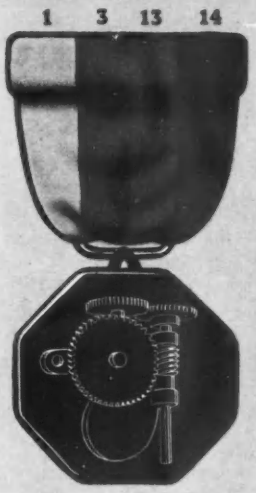
Captain Dag (a campaigner who will never be mustered out) represents Dag brand colloidal graphite, the smooth, black liquid concentrate which serves so many different war industries. Capt. Dag may take the form of a dry film, a fluid film, a surface coating, an impregnation, etc.

PHYSICAL AND CHEMICAL PROPERTIES

1. Slippery—A Good Lubricant. Softer than Talc
2. Conducts Electricity
3. Withstands Temperature Extremes
4. Absorbs, Radiates and Conducts Heat
5. Maximum Purity
6. Low Coefficient of Expansion
7. Particles Bear Like Electric Charges
8. Insoluble in Acids and Alkalies
9. Black and Opaque
10. Gas Adsorbent
11. Little Photoelectric Effect
12. Miscible with Most Fluids
13. Films Adhere Tenaciously and Dry with Sharp Edges
14. Microscopically Fine Particles. Penetrates Fine Pores
15. An Excellent Suspension

1, 3, 8, 14, 13, 6

CITATION: "We have been enthusiastic users of Dag colloidal graphite for more than ten years. We find it the only material which will prevent bolts, nuts and flanges from seizing under the high temperature and pressure conditions in our boilers and steam systems."

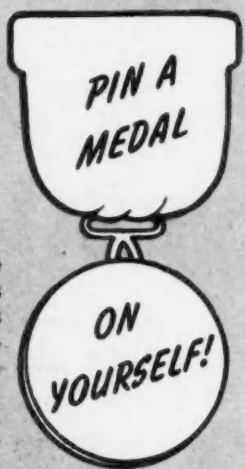


1, 3, 13, 14

CITATION: "Dry films formed from Dag colloidal graphite supply durable lubrication on parts which could not be effectively lubricated otherwise. Such films are functioning at temperatures from (—60° F. to +1200° F.) and higher."

2, 4, 13, 10, 11, 3

CITATION: "Graphite films when applied to the grids (and frequently the plates) of radio tubes for receiving and transmitting, are useful for minimizing secondary emission, 'back' emission and photoelectric effects."



For easy reference we've given colors to Captain Dag's most valuable properties. Match these colors with the performance "citations" above. Then pin a medal on yourself for putting Captain Dag to work in your plant. He's one campaigner who won't be mustered out.

Dag, Oildag, Aquadag, Castordag, Glydag and Prodag are registered trade marks of Acheson Colloids Corporation. Copr. 1944 by Acheson Colloids Corp.

dag COLLOIDAL PRODUCTS

ACHESON COLLOIDS CORPORATION

PORT HURON, MICHIGAN

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AIRCRAFT
Wheels and Brakes

. . . IN GOOD COMPANY

"Delivering the Goods" . . . that's the military and civilian salute to aircraft manufacturers and airlines. Hayes is proud to engineer and build the kind of wheels and brakes that help win that salute for thousands of planes—including:

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CHANCE VOUGHT
COLUMBIA
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CURTISS-WRIGHT
DOUGLAS
EDO
FAIRCHILD
GRUMMAN
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★ **All U. S. 4-Engine Bombers**
including
Boeing B-17 and B-29
Consolidated B-24
are equipped with
HAYES WHEELS and EXPANDER TUBE BRAKES

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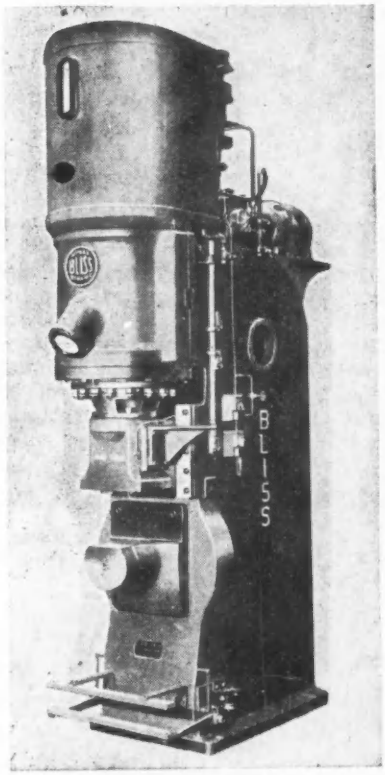
HAYES INDUSTRIES, INC. Home Office: JACKSON, MICHIGAN, U. S. A.

New Production Equipment

(*Continued from page* 38)

E. W. BLISS CO., Brooklyn, N. Y., has recently built a new design of horn press which is used in the manufacture of truck rims. The press frame is an



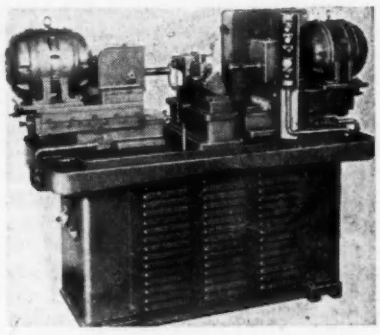
Bliss horn press

extremely heavy steel casting in which the horn and the 300-ton hydraulic cylinder are mounted. The slide of the press is guided on the frame and can be provided with a shouldered slide cap if necessary. As this press was required for coining work, a comparatively small 20-hp pump was installed, but larger pumps can be incorporated on the same press to provide faster speed. The economy involved in using a small pump on coining work is said to be quite feasible with the Bliss Hydro-Dynamic system, since its normally open prefill valve and positive drive to the work permits quick build-up of pressure. Cavitation is reduced to an absolute minimum and the press itself is self-purging of air. Electric control by both hand and foot button is provided with either automatic reverse or reverse by the release of the foot treadle. The non-repeat device is incorporated in the automatic reverse.

SNYDER TOOL & ENGINEERING CO., Detroit, Mich., offers a small two-way machine which can be used for a wide variety of drilling and reaming operations.

The machine slides are way-type and are individually fed by hydraulic cylinders. A single-spindle drill head and drive motor are installed on a dove-tail sub-slide which is provided to permit adjustment of tools and the exchange of tools. The hydraulic feed on the unit is approximately four inches. The fixture on the machine is quick-acting, air-clamping type. The base is welded steel and contains the hydraulic equipment for operating the slides.

On parts running into high produc-



Snyder two-way machine for drilling and reaming

With National Security Fully Served—

Johansson Gage Blocks

Available Without Priority

Johansson Gage Blocks, heretofore available only through AA-1 priority, are now available without priority.

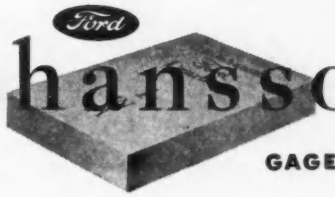
The manufacture of chrome-plated Johansson Gage Blocks, discontinued since July, 1941 in the interests of meeting urgent production requirements for our regular steel Gage Blocks, has been resumed.

In accordance with the arrangements previously in force, worn sets of Johansson Gage Blocks may now be returned to the factory, on an exchange basis, for new chrome-plated sets. This economical salvage service applies, of course, only to Johansson Gage Blocks, any of which (down to size 0.050") can be surfaced accurately with chrome plating. Write for new Price Schedule. D.AA

FORD MOTOR COMPANY, JOHANSSON DIVISION, *Dearborn, Michigan*

Ford

Johansson



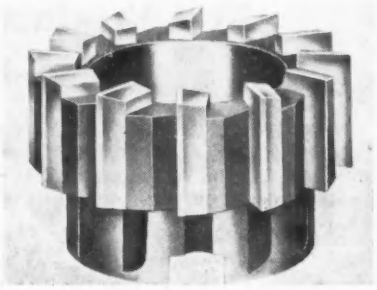
GAGE BLOCKS

tion, where the operation is not especially complicated, this machine can be equipped with hopper or magazine to feed the parts into the fixture.

CARBIDE-TIPPED cutters in two grades for tool holders are the latest addition to the line of Armstrong Bros. Tool Co., Chicago, Ill. The cutters tipped with Armide Red are for machining steel while those tipped with Armide Gray are for machining cast iron, brass, bronze, aluminum, and nonmetallics.

Additions also have been made to the line of Armstrong carbide tool holders which now come with straight, right hand offset or left hand offset shanks, each in seven sizes.

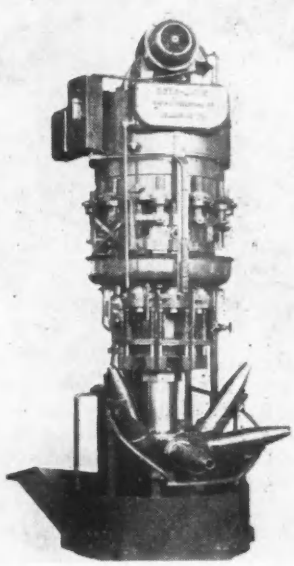
SMALL standard shell end mills with brazed-in blades made of Haynes Stellite cobalt-chromium-tungsten alloy are available from Haynes Stellite Company, Kokomo, Ind. These cutters are furnished with blades of either Haynes Stellite 98M2 or Star J-Metal brazed into a steel body. Diameters range from 1¼ to 6 in., with face thicknesses from 1 to 2¼ in. These cutters are supplied ready for use. They are used for milling aluminum, bronze, cast iron, brass, alloys, and some steels.



End mill with brazed-in blades of Haynes Stellite

A RECENT development made by the Davis & Thompson Company, Milwaukee, Wis., adapts an 8 spindle "Roto-Matic" driller to the reaming of the nose end of 155 mm H.E. shells.

As the machine rotates the outside cam carries the shell into the clamping position. At a pre-determined point the cutter spindles automatically feed and at the same time actuate the clamping mechanisms. On the completion of the operation, spindle is automatically withdrawn and clamping mechanism released. Machine operation is continuous and non-indexing with clamping and spindle feed being automatic. Two operators load and unload the shell cases while the machine is in operation. Gross production is 300 shells per hour.

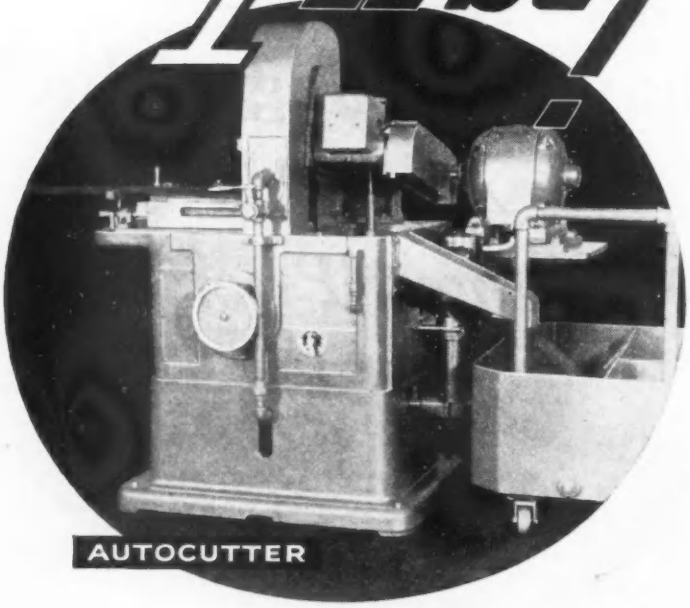


D & T "Roto-Matic" vertical reaming machine

Budd Receives ASME Medal

Edward G. Budd, founder-president of the Edward G. Budd Manufacturing Company of Philadelphia, was honored by the award of the A.S.M.E. Medal at the annual dinner of the American Society of Mechanical Engineers held at New York. The Award was presented "because of his outstanding engineering achievements."

IT'S A First



Yes, this **CAMPBELL "MODEL 700"** is the first *fully automatic* abrasive cutting machine ever built. Coming from **CAMPBELL**, manufacturers of the most complete range of abrasive cutters, that's big news.

This **"700"** is "first" another way. It is the opening announcement of **CAMPBELL'S** post-war program of development, based on wartime improvements all through the line. Other announcements will follow.

Maybe there's a way a **CAMPBELL ABRASIVE CUTTER** could speed up or economize your production. It's easy to find out.

WHY NOT DO THIS:

Write and tell us (1) the range of sizes, (2) kind of material, (3) length of cut-off pieces, (4) length of stock before cutting, (5) tolerance for length of cut pieces and (6) hourly production requirement. With this information, **CAMPBELL** engineers can recommend production procedure and work up cost sheets for you.

Campbell ABRASIVE CUTTING MACHINES

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AMERICAN CHAIN & CABLE COMPANY, Inc.
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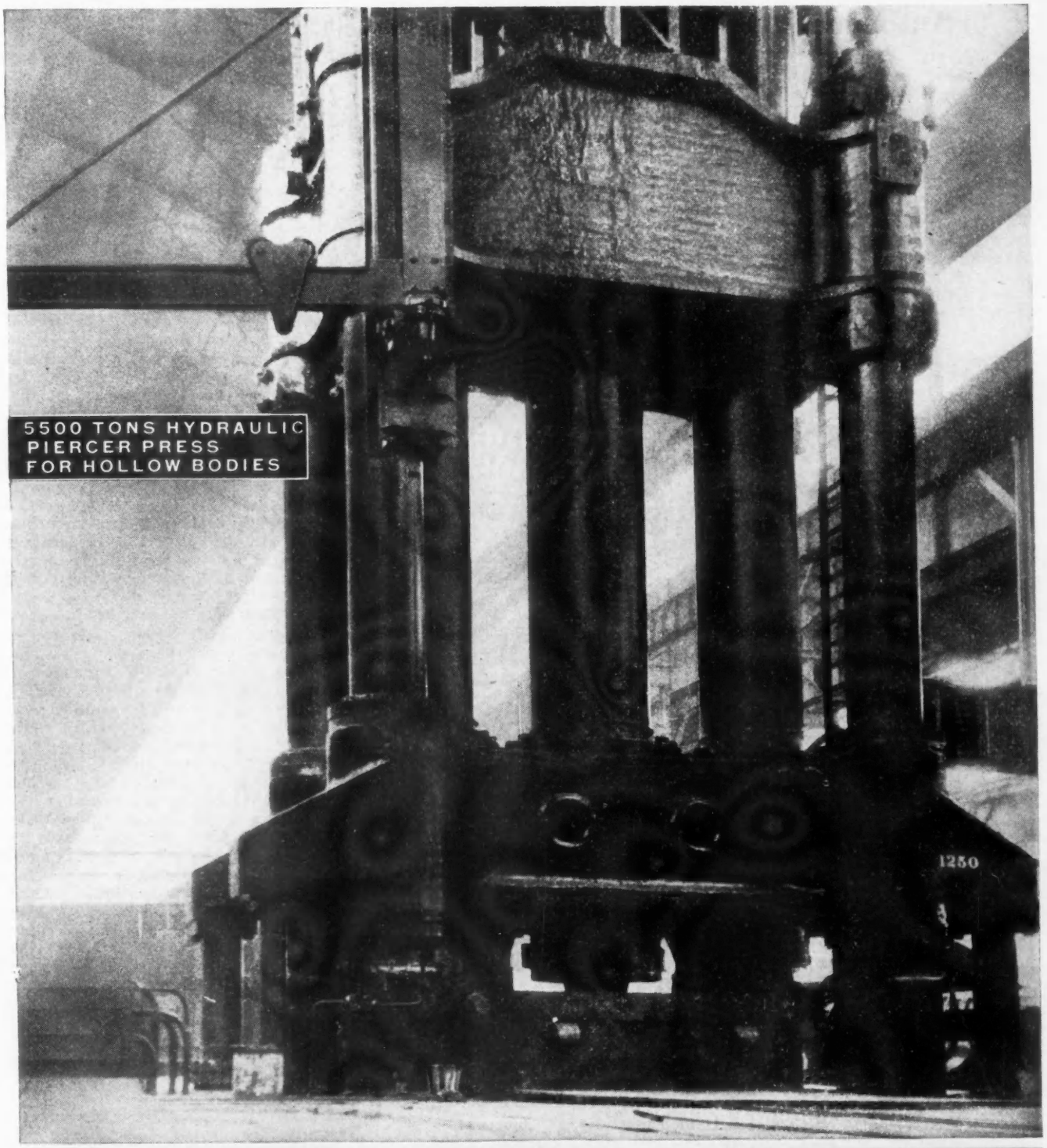

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Automatic Temperature Recording

(*Continued from page* 35)

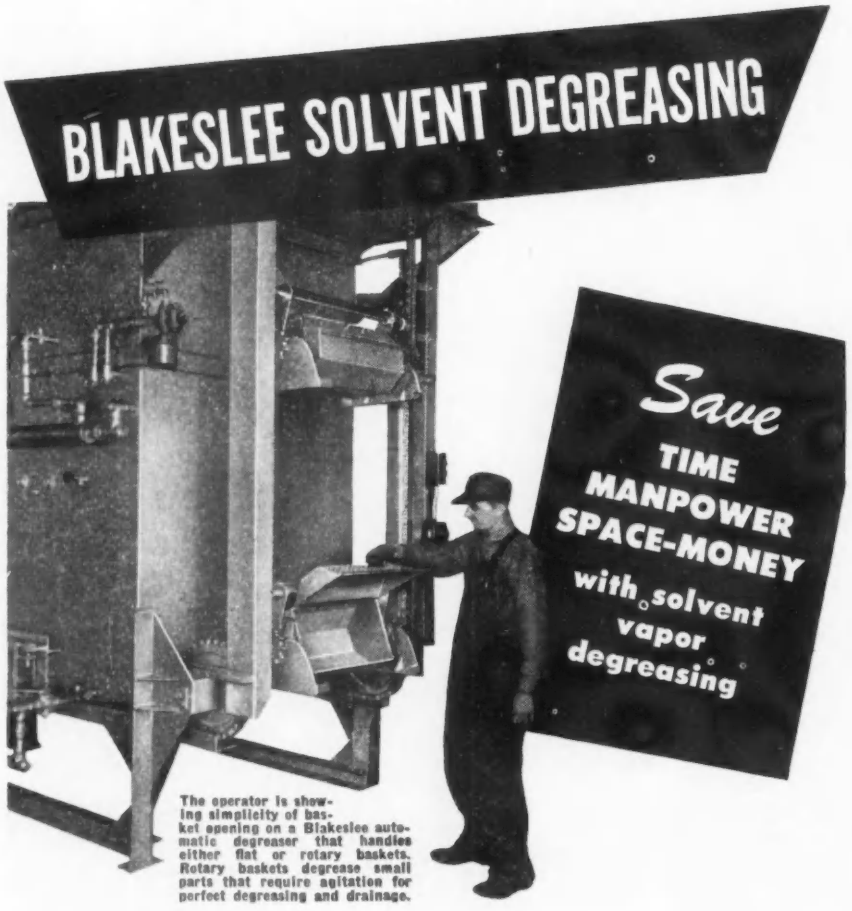
was about the maximum which could be handled successfully by one automatic recorder.

When in proper operation switching unit No. 4 has been selected, it is in step with S.R. 9 on the control panel. Thus the position-indicator lamp on the control panel indicates which point of measurement the switching unit is connected to. The impulse which advances S.R. 4 and S.R. 9 from the 24th to the 25th position also advances S.R. 11 one position. This is provided for by the single-pole, single-throw relay on the control panel. The three-pole double-throw relay of the control panel is then caused to operate, and it accomplishes two purposes. First, it prevents any of the 25-point rotary switches from advancing until S.R. 11 has reached the position of the next switch unit selected. If one or more of the following banks are omitted, it also causes S.R. 11 to advance one position upon the impulse which advances S.R. 4 and S.R. 9 to the 25th position. The re-cycle switch is placed in the 11th position of S.R. 11, at which time the off-normal controls of S.R. 11 are open, thus preventing S.R. 9 from being impulsed by the recorder when the system is otherwise inoperative.

By opening the re-cycle switch, the system may be stopped at the completion of one sequence of operation. Otherwise it is in continuous operation.

The electronic-control amplifier performs two functions. First, it gives an instantaneous indication of whether or not the switching unit is out of step with the control panel. Second, if this is the case, it provides the means by which they may be brought into step. It may be remarked at this time that if the switches are properly adjusted, it is practically impossible to get them out of step, even when trying deliberately to do so, regardless of the duration of the impulses employed. The operation of the electronic-control amplifier is dependent upon an unbalanced condition of the aforementioned bridge, which only occurs if the switching unit and control panel are out of step. If this is the case, then a signal voltage is applied to the input of the amplifier, placing an amplified signal on the grid of the second tube. This tube is biased to cut-off for zero applied signal voltage. Thus, when a signal is applied to the amplifier, the amplifier relay is closed, which lights the warning lamp on the control panel, indicating that the switching unit and control panel are out of step. When this occurs, by merely throwing the "clear" switch, the rotary switch S.R. 9 of the control panel is caused to "home around" until it is once more in step with the switching unit. This homing operation is controlled by the amplifier, for as soon as the rotary switches are in step, the bridge being once more balanced, the relay in the amplifier opens, thus stopping the homing operation. The "clear" switch may also be used to hold the system on any desired point, since by putting the switch in the "clear" position the impulse circuit is opened, preventing further impulses from reaching the system.

A word of caution is in order concerning the bridge circuit. The 50-ohm resistors used were of the ½-watt, wire-wound type. In order to assure balance, the resistors were sorted into ranges of ±½ ohm from established mean values. All resistors measuring accurately certain key values, such as 49, 50 and 51 ohms, were set aside as "precision" resistors. This stock was then drawn upon in building up the control panels, which thus contained 23 resistors of equal values to precision tolerances. In the switching units there is a random variation of ±½ ohm from the mean value. The average, however, will be statistically close to the value which would be obtained if all resistors were precision-selected. The reason for



The operator is showing simplicity of basket opening on a Blakeslee automatic degreaser that handles either flat or rotary baskets. Rotary baskets degrease small parts that require agitation for perfect degreasing and drainage.

Degreasing the Blakeslee Solvent Vapor way is economical. Blakeslee compact thoroughness and speed whether the parts be large or small, chip laden, coated or oily, gives greatest satisfaction and most dependable results. Saves time—makes money.

Remember Blakeslee when considering degreasing either in general or special ways. There is an ideal model for every application.

May we send our engineers? Complete descriptive literature upon request for either degreasing or Blakeslee highly efficient metal parts washers.

G. S. BLAKESLEE & CO.

Main Office and Plant: Cicero Station, Chicago 50, Illinois
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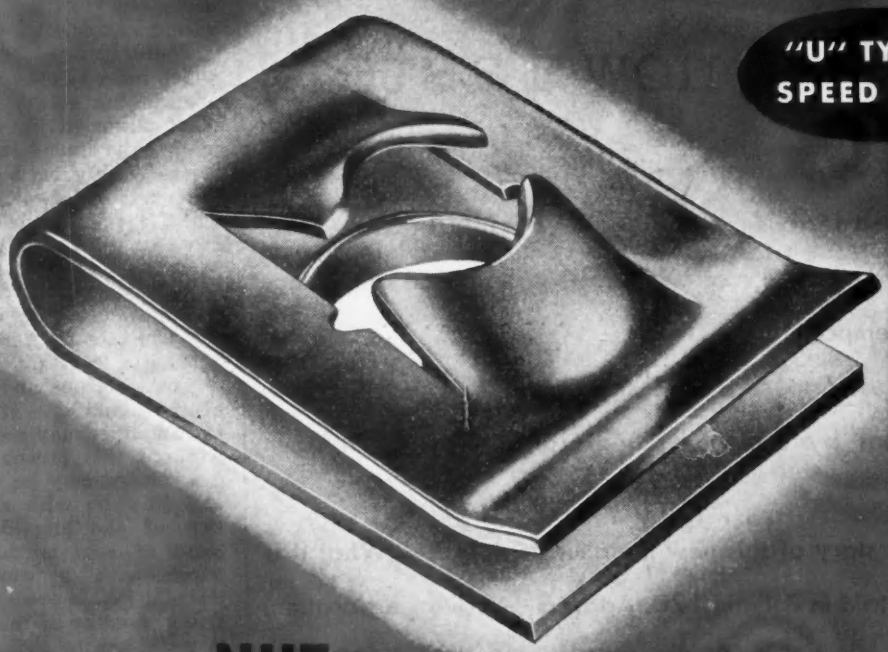
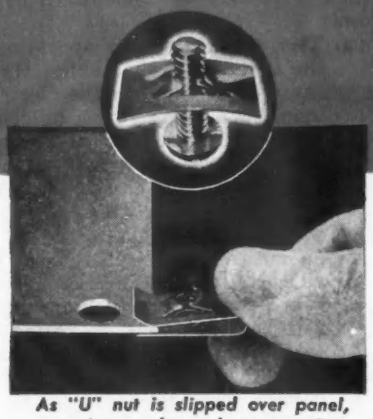
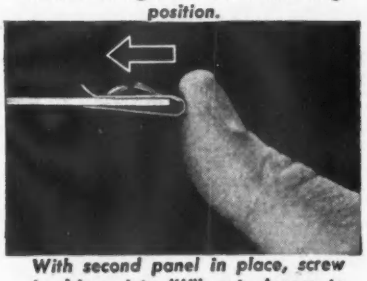
ONE OF A SERIES PORTRAYING THE "SPEED NUT FAMILY OF FASTENERS"



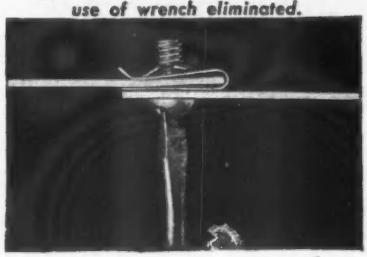
HERE'S THE NUT THAT *Holds itself* IN PLACE!



As "U" nut is slipped over panel, extrusion on lower leg snaps into hole—locking nut in screw-receiving position.



With second panel in place, screw is driven into "U" nut. Access to opposite side is unnecessary and use of wrench eliminated.



Here is a spring steel lock nut that broadens the smile of engineers and assemblymen everywhere. No more fussin' or cussin' over blind location fastening problems. No more expensive welding, riveting, or clinching nut plates in location. For "U" type SPEED NUTS merely snap into holes along the edge of panels, brackets, or flanges.

An extrusion formed in the lower leg of the "U" nut snaps into the screw hole and retains the nut in perfect register until final assembly. By varying the size of the hole, any degree of "float" may be obtained, to compensate for misalignment.

In addition to simple and speedy application, "U" type SPEED NUTS possess exceptional holding power and their arched prongs absorb vibration to definitely prevent loosening. Millions of "U" nuts were used on metal, wood, and plastic products before the war—millions more are being used today on war equipment. And postwar products that will capture the biggest markets will be assembled faster and at lower costs with SPEED NUTS. The men with the assembly "know-how" are the ones who move up the fastest. Write today for literature.

TINNERMAN PRODUCTS, INC.
2059 FULTON ROAD, CLEVELAND 13, OHIO

*Speed Nuts** PATENTED
*Trademark Reg. U. S. Patent Office

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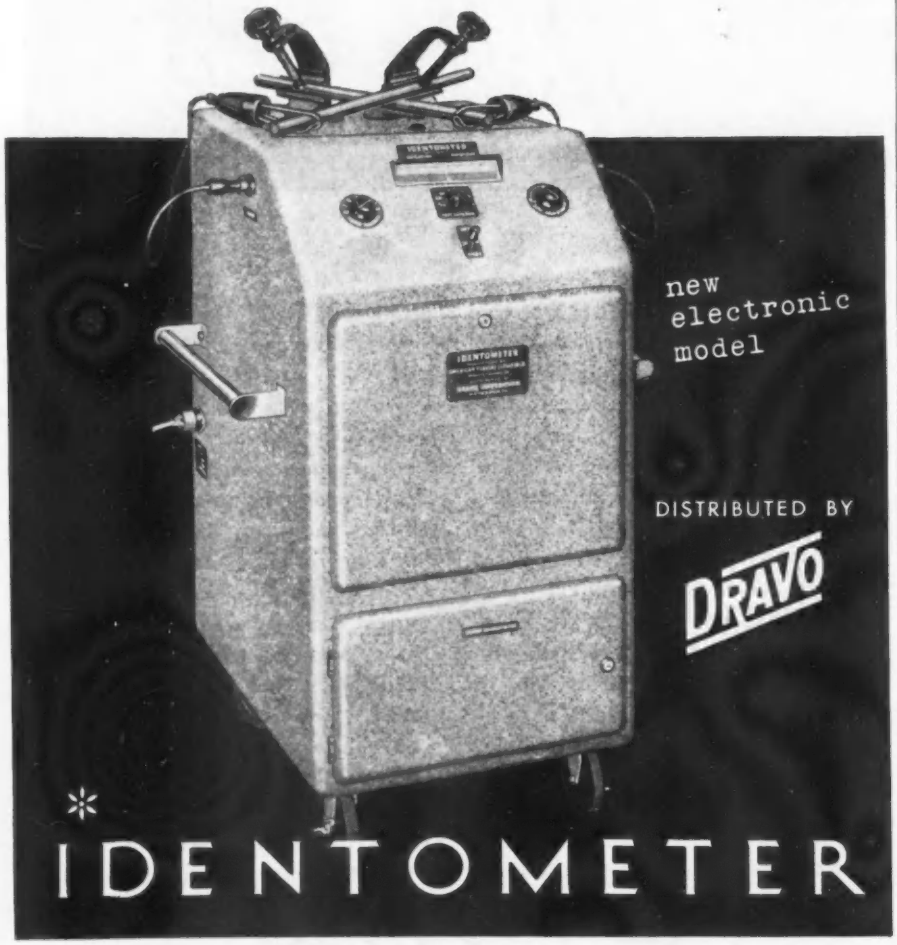
POSITIVE STEEL * IDENTIFICATION

now faster!

On the new Identometer, equipped with an electronic timing device, most rolled or forged ferrous materials can be tested against known samples for positive quality control at speeds that will keep pace with modern shop tempo.

Identometer is used to sort steel stocks and to check material against specifications by comparing heats at any practical point during processing.

Read the whole story of this new metallurgical tool! —What it is and how it works is told in Bulletin 12D. Address—Dravo Corporation, National Department, 300 Penn Avenue, Pittsburgh 22, Pa.



AN ELECTRICAL INSTRUMENT FOR THE INSTANT AND ACCURATE IDENTIFICATION OF MOST ROLLED OR FORGED FERROUS ALLOYS BY THE USE OF REFERENCE SPECIMENS

using precision-sorted resistors in the control panel is that it minimizes the effect of these random values of resistances in the switching-unit section of the bridge circuit. It is thus unnecessary to buy bulky precision-wound resistors.

There is one further precaution which must be observed. The power to operate the rotary switches, the filament power of the tubes, and the d-c bias of the second tube of the amplifier are obtained from a suitable d-c source, in our case 24-volt storage batteries. The 110-volt a-c to operate the bridge circuit and to supply the plate voltage of the amplifier must be obtained from this same source, either through a rotary converter, a vibrator supply, or the equivalent. This is necessary to provide a constant ratio between the d-c bias voltage and the plate voltage of the amplifier. If this is not done, the amplifier may not operate properly, while if this precaution is taken, the d-c voltage may be varied between 18 and 30 volts with satisfactory operation of the amplifier. One further point of note is that the system as wired with a common ground to chassis, etc., is predicated upon a negative grounding of the d-c source, which is necessary to obtain the proper bias on the last tube of the amplifier.

The basic features of operation of the system may be summarized as follows:

a. Two checks on the operation of the system are available. One of these is provided by the electronic amplifier and the associated bridge circuit. If the control panel and switching unit drop out of step, an unbalanced condition of the bridge circuit is created and the warning lamp is lit. The second of these checks is provided by the bank lamp circuit. When the system has reached the 24th position, the following impulse puts the switching unit on the 25th or "off" position and advances the control panel to the next switching unit selected. If the bank lamp of the first switching unit remains lit, it simply indicates that the switching unit was not left on the 25th or "off" position, and was therefore out of step with the control panel. This is an absolutely positive check on the operation of the system.

b. A reference temperature position is provided once every 25th impulse by the 25-point rotary switch in the control panel. This may be used for ice-bath or hot-bath reference, as desired, to provide a constant check on the recorder.

c. As the control panel advances from one switching unit to another, the relay, as R41 in switching unit 4, is opened in one switching unit and the corresponding relay is closed in the following switching unit. This positively prevents more than one switching unit from being placed across the

Engineering

Forty-one years' specialization has given the Long organization an unusual background of experience in heat exchange unit engineering and manufacture. War accelerated new developments, many new applications, and added substantially to our knowledge of the field. This engineering and manufacturing experience will be turned back to peacetime production when peace comes.

LONG MANUFACTURING DIVISION
BORG-WARNER CORPORATION
DETROIT 12, MICHIGAN • WINDSOR, ONTARIO

LONG

CLUTCHES • RADIATORS • OIL COOLERS

recorder circuit at one time.

d. When the re-cycle switch is opened, the control panel will go through one sequence of operations and stop. If the re-cycle switch is closed, the system is placed in continuous operation.

e. By throwing the clear switch to the "clear" position it is possible to stop the system at any desired point for a detailed inspection of this temperature. If the system is out of step, this will also automatically bring the control panel into step with the switching unit.

As may be seen from the illustrations, mechanically the system is very rugged. Experience has shown that in actual service this is absolutely necessary, because no matter how careful instrumentation personnel may be, over a period of time the equipment is invariably subjected to considerable abuse. The cases are hermetically sealed, and a dessicator excludes moisture (corrosive salt air in locations near the seacoast) from the compartments. This prevents excessive corrosion of the switch contacts and reduces servicing needs. It was found that the application of a little lubricant to the stationary switch contacts tends to keep them clean. Beacon lubricant M-285 is used.

Automatic temperature - recording systems as described in this paper have been used by the Douglas Aircraft Co. sufficiently long to eliminate the "bugs" usually found in newly-developed equipment, and the apparatus in its present form is performing very satisfactorily. The success of this development is due in no small measure to patient cooperation between the men in the Douglas Research Laboratories who built the apparatus and the flight engineers who used it.

British Austin

(*Continued from page* 36)

from the integral induction and exhaust manifolds with a central hot spot. A T-shaped air silencer is fitted. Fuel feed is by mechanical pump from an 8 Imp. gal tank.

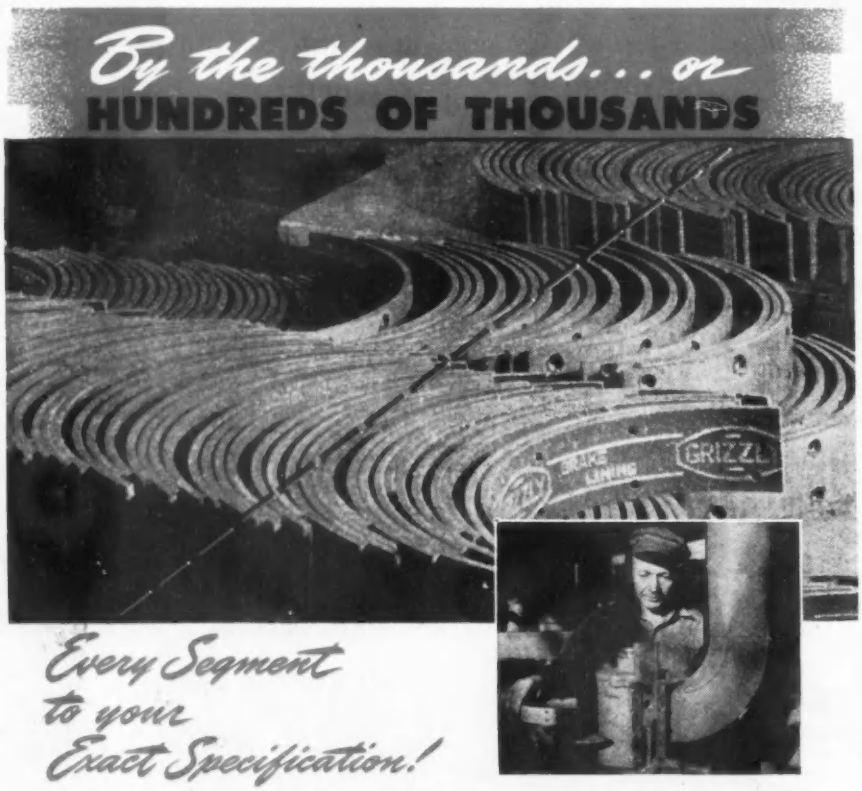
The water circulating system is on lines new to British automobile practice in general. From the belt-driven pump, at the rear end of the ball-bearing fanshaft, water passes to a gallery integral with the cylinder block at the upper end on the right-hand side. From the gallery, jets of water are led laterally into the cylinder jackets and larger ones vertically into the cylinder head jacket, where they are directed initially around the valve seats and spark plug bosses. There is water spacing between all contiguous cylinders extending the full length of the bores. Engine, clutch and four-speed transmission are flexibly mounted as a unit, at the front on a pair of rubber blocks arranged as a vee and at the rear on a combination of horizontal and vee mountings. The transmission is conventional, having synchromesh for the 2nd, 3rd and top gears. The overall ratios of the Austin Sixteen are: first 15.3, second 10.1, third 6.4 and top 4.1.

Austin has not yet adopted independent front suspension, for even this most recently developed model has half-elliptic springing front and rear, though torsion bars are fitted to check rolling. Girling brakes are used at front and rear. Steering is by Bishop cam gear and a spring-spoked wheel. Final drive from the Hardy-Spicer propeller shaft and needle-roller universals is by spiral bevels and three-quarter floating shafts.

The body represents no striking departure from the general lines of 1939 Austin cars of 12-16 lb. hp. The interior is 45 in. wide across the separate and adjustable front seats, while the rear seating is 46 in. wide with 59 in. of elbow room.

The principal car dimensions are: length—171 in.; width—68 in.; height—64½ in.; wheelbase—104½ in.; front tread—53½ in.; rear tread—56 in.

Nothing can be stated yet about prices—it is not known yet whether and, if so, on what scale the Government will continue to apply the Purchase Tax to automobiles. At present the tax runs as high as 33 1/3 per cent on the wholesale price.



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Pioneers in advanced production techniques, Grizzly long ago learned the importance of producing the *best product, most economically* . . . that's why Grizzly is known as "the finest product of the Brake Lining Industry."

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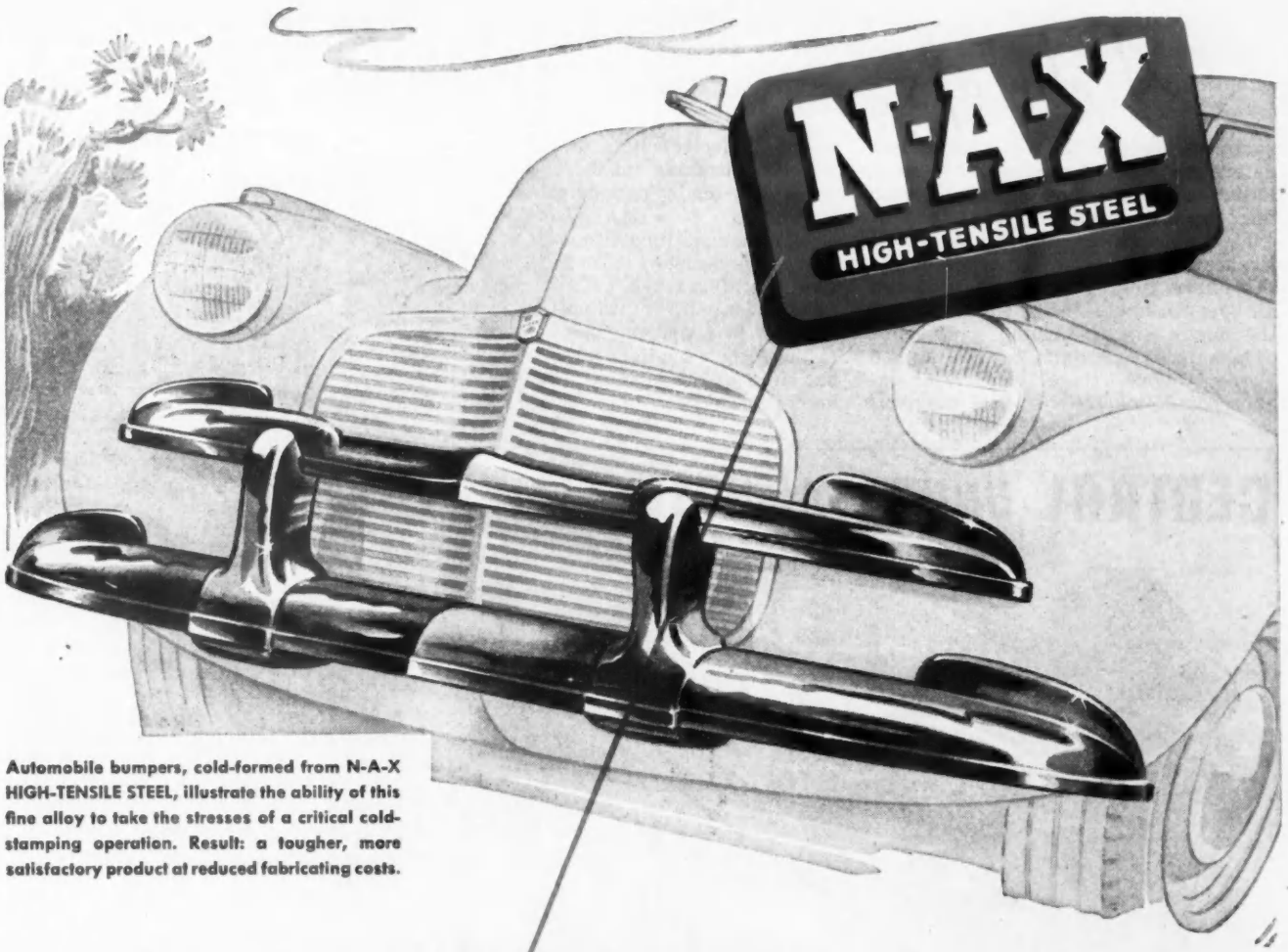
BRAKE LINING



Automobile bumpers, cold-formed from N-A-X HIGH-TENSILE STEEL, illustrate the ability of this fine alloy to take the stresses of a critical cold-stamping operation. Result: a tougher, more satisfactory product at reduced fabricating costs.

THIS HIGH-TENSILE STEEL "TAKES OVER" WHERE DRAWING STRESSES ARE TOUGH

N-A-X HIGH-TENSILE STEEL has stepped into some tough spots in the production of intricate shapes. It has proved to production men that here is a great steel to work with, from the standpoints of both manufacturing operations and finished performance.

To put it in a few words, N-A-X HIGH-TENSILE STEEL has what it takes to make a stronger, tougher product through more efficient production methods. Its exceptional ductility and resistance to impact, inherent in the fine grain structure of a great alloy, often make possible the speed and economy of cold-forming on pieces which must be worked hot when other grades of steels are used. And where critical drawing stresses require hot work, N-A-X HIGH-TENSILE STEEL provides the important advantage of maintaining its high physical properties with minimum cooling distortion even after it has been subjected to a wide range of temperatures. No subsequent treatment is needed to maintain "as rolled" specifications.

Add to these advantages the high fatigue life and resistance to corrosion and abrasion that qualify N-A-X HIGH-TENSILE STEEL for varied types of applications, and you'll see why this fine-grain, low-alloy steel is a factor in postwar planning. Great Lakes Steel metallurgical service is yours on request: Let's have your problem.

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Division of NATIONAL STEEL CORPORATION. Executive Offices, Pittsburgh, Pa.

GREAT STEEL FROM GREAT LAKES

HIGHLIGHTS OF N-A-X ALLOY STEEL

N-A-X HIGH-TENSILE STEEL compares favorably with other low-alloy high-tensile steels in yield and tensile strength, with outstanding ductility and notched bar values. In applications where it replaces mild-carbon steels, it serves to reduce weight or increase strength through the utilization of these properties in design.

Another property that may interest you is the excellent weldability of N-A-X HIGH-TENSILE STEEL—whether welded to itself or to other high-tensile or structural steels of welding quality.

N-A-X 9100 SERIES STEELS are produced in carburizing and constructional grades. Except for carbon, they have a chemical analysis that is constant within definite ranges. Together with X-9100 Series steels, containing molybdenum, they provide hardenability ratings to cover a wide variety of requirements, yet give an all-purpose analysis to yield properties. Molybdenum confers great depth hardenability to extend the usefulness of the N-A-X 9100 Series, which are medium-hardening steels.

N-A-X ARMORPLATE is an example of the exacting requirements that Great Lakes can meet with this low-alloy series. One of the X-9100 Series steels is the basis of the armor we produce for tanks, armored cars and practically all landing craft.

Airbriefs

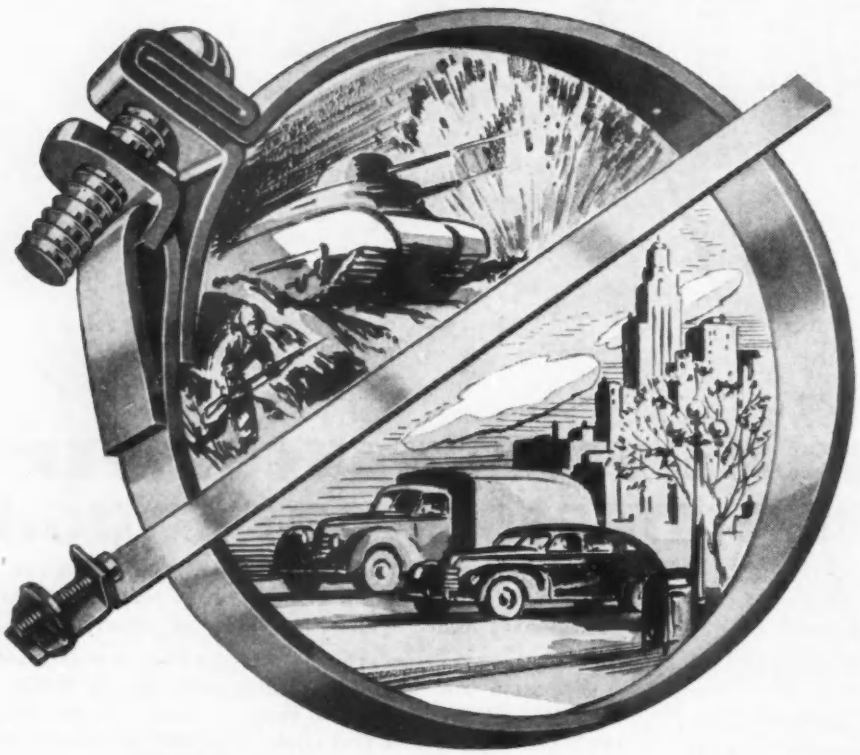
(Continued from page 40)

strument panel that the pilot cannot determine which propeller to feather. Later on the question of braking with the prop is handled.

I can remember returning from France in 1935 after the trials of the Chauviere fully controllable propeller all "pepped up" with the advantages of the device and describing it to some of the technical staffs of the Armed Forces. Were these gentlemen enthused? Not a bit! In fact they told me that any attempts to use the propeller for braking would probably wind up in disaster by putting the plane out of control. Now the AAF has completely changed its attitude as propeller braking is declared to be "just as effective overall as the best wheel brake installations in retarding the roll of aircraft." I am not taking exception to the former opinions of the Air Force but simply to the general attitude, past and present, in our Armed Forces against most new ideas in favor of the mass production of old things. This idea has had some pretty bad shocks during the present war, but still persists "high up" in no uncertain degree.

The magnetic mine was proposed here in the early 1920's but was turned down until the Germans used it. The fully controllable and reversible pitch propeller was available years abroad before it was given any real thought here. The robot bomb was invented by an American. The rocket guns, jet aided take-off, jet propulsion, rocket projectiles and a host of other things have been German "firsts" in this war and only adopted with great reluctance by our Armed Forces. I have been told by numerous practical men, not "nut inventors," that they meet with very cold reception by the representatives of the Armed Forces when they go to Washington and elsewhere with new devices, being told that "orders from higher up are that we are to produce what we now have in mass production and not upset our manufacturing set up by trying out new ideas." Mass production is necessary in arms just as in building automobiles, but in normal times the motor car manufacturer has year after next's car under way this year.

CENTRAL *UNIVERSAL* HOSE CLAMPS



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A SINGLE LENGTH FITS OVER 100 HOSE SIZES

SEND FOR FREE SAMPLE No. 44-12A

• ***For Production*** . . . The superior quality of Central *Universal* Hose Clamps has been repeatedly demonstrated in hundreds of thousands of Army and Navy combat vehicles, and over a period of many years in civilian cars, trucks, farm and road-building machinery.

• ***For Service*** . . . Easy to use in hard-to-get-at places; quickly installed or removed without disconnecting the hose lines; rust-proof, leakproof, self-locking; 100% universal . . . Eliminates need for different size clamps; meets every service requirement.

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Materials

Few people in industry realize just how well aluminum alloys fitted into the aircraft picture. Many of them can be heat treated to definite properties then worked cold still in their annealed condition until the heat treatment "ages." Were this change to take place immediately it would be impossible to fabricate most of the plane structures now being made and to treat them. If someone could invent a plastic which could be formed and be soft or pliable, remaining so for a day or so and then harden as hard as glass and stay that way without checking or crazing, many of our pressing problems would be solved. The use of clear plastics has been proposed for everything from windows to camera lenses, but still have the fault of scratching more easily than glass.

Stewart-Warner Offices Moved to New Address

Sales, advertising and service department offices of the Stewart-Warner Corporation are again located at the corporation's main plant, 1826 Diversey Parkway, Chicago. Removal from temporary war-time quarters in the Builders' Building, 228 North LaSalle, to a newly converted general office building at the Diversey address, was completed a short time ago. The Alemite, instrument and radio departments were included in the move, after sixteen months at the downtown location.

Lodge & Shipley Lathes at work

. . . ACHIEVING A 250% INCREASE IN PRODUCTION OF TRANSMISSION MAINSHAFTS AT AUTOCAR

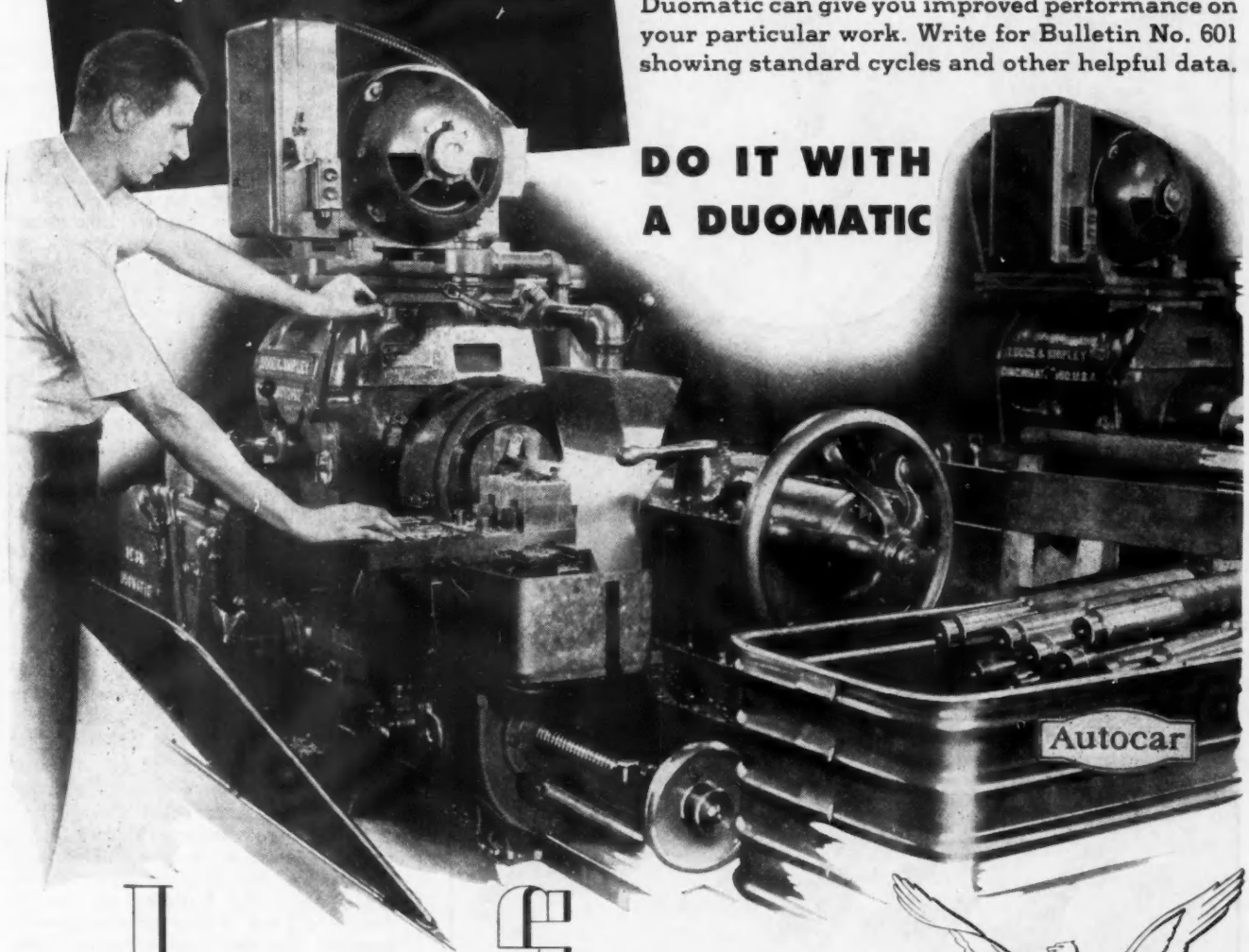
• Men responsible for greater output of Autocar's famous heavy duty trucks, are convinced of the unusual efficiency of Lodge and Shipley's full automatic lathe—the Duomatic. Here is what these production-minded men have to say about Duomatics they recently installed:

"Our transmission mainshafts are finished in four operations—two roughing and two finishing. The combined floor-to-floor time of these four operations is approximately 18 minutes. We previously used engine lathes on this part. Now, with our new Duomatics, we show a production increase of 250% over the old method."

In shops of every size and type, handling large or small lots, the Duomatic repeatedly demonstrates its amazing efficiency. Dual tool slides—front and rear—operate singly or together . . . are easily swiveled to cut from any angle. All movements and set-ups are entirely mechanical.

Have Lodge and Shipley Engineers show how the Duomatic can give you improved performance on your particular work. Write for Bulletin No. 601 showing standard cycles and other helpful data.

DO IT WITH A DUOMATIC



THE LODGE & SHIPLEY MACHINE TOOL CO.

CINCINNATI 25, OHIO, U. S. A.

L & S LATHES

ENGINE—TOOL ROOM—AUTOMATIC—OIL COUNTRY LATHES

The Navy Looks to the Automotive Industry

(*Continued from page* 17)

In fact, as the program developed it became necessary to draw upon practically every engine builder of record in the interest of maintaining the small craft building program.

Automotive type Diesel engines constitute the main propulsion for the vast armada of landing craft and other small military ships. Largest single contributor to the landing craft program was the Detroit Diesel Engine Division, GMC, credited with building more than 100,000 units of the famous 6-71 Diesel engine. A large proportion of this was in the form of marine conversions made by the Gray Marine Motor Co., now a subsidiary of Continental Motors Corp. For auxiliary power and for Lend-Lease requirements of our Allies, the Navy drew upon all engine builders for Diesel and gasoline engines.

While it is not feasible to catalog the applications of makes and types of automotive engines, nor compatible with military security to give details of installations in all military craft, it is possible to list the engine builders contributing to the Navy program and to give a sampling of their applications.

Detroit Diesel-Gray Marine engines were employed for main propulsion of a large variety of landing craft, including LCI (L) vessels which use the Detroit Diesel Quad (bank of four engines). In addition, Detroit Diesel powered generator sets using the 2-71 and 3-71 engines. Cleveland Diesel Div., GMC., built generator sets and main propulsion units for many of the LSM vessels and the LST's. Electro-Motive Div., GMC., produced main propulsion plants for the LST's; and earlier in the program, when the Nazi submarines were prowling the high seas, produced the so-called pancake engine for the versatile 100-ft. SC's (submarine chasers).

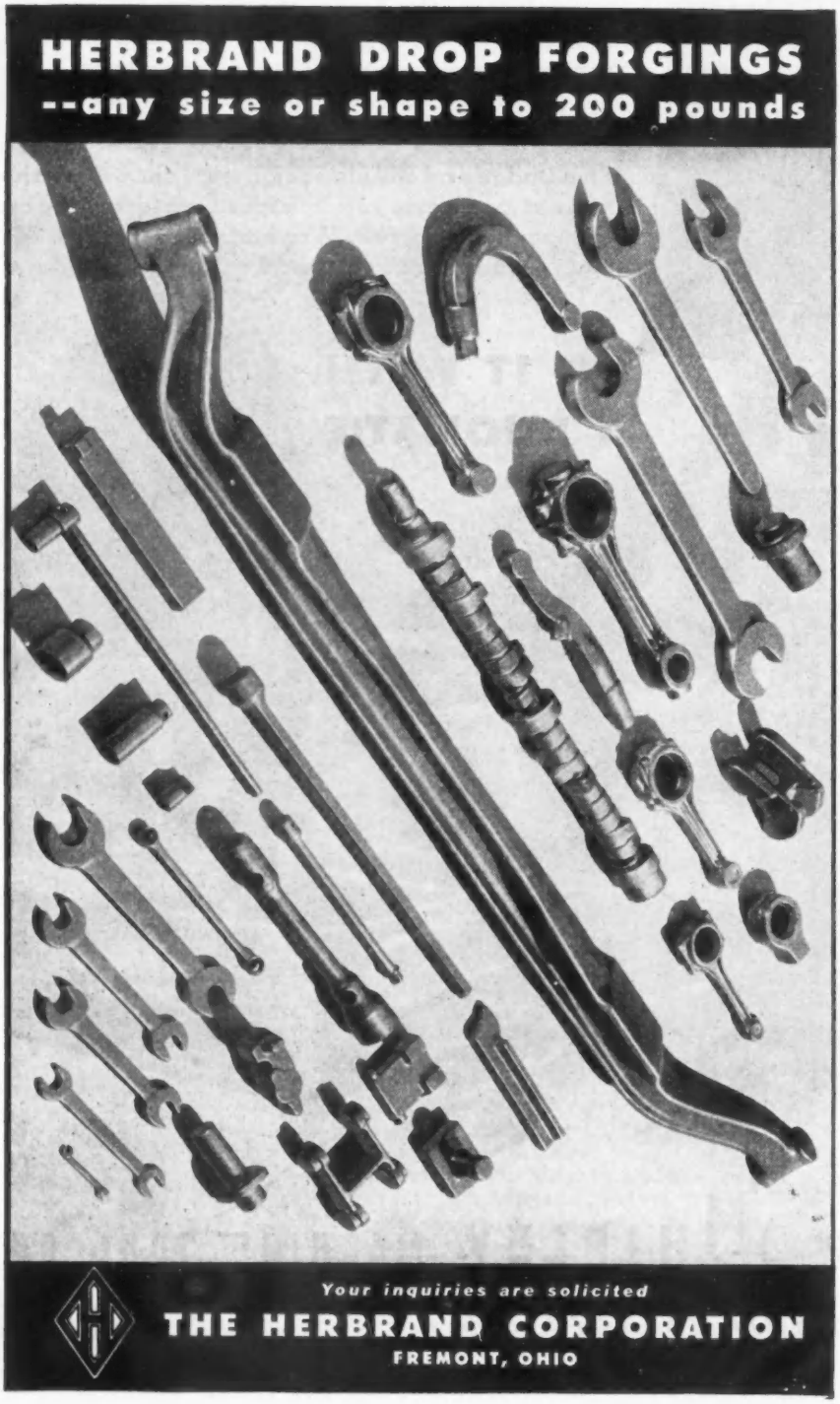
The famous Packard 2500 Series marine engine has been standard on the mighty PT's and has been supplied in large numbers on Lend-Lease. Chrysler marine engines have gone into small Lend-Lease landing craft, for the well-known Sea Mule used by the Seabees, while other models have been built for airport firetrucks, for welding generators, for winches, pumps, etc. Continental Motors Corp. engines have been used for auxiliaries and earlier for main propulsion of some Picket Boats. Cooper-Bessemer Diesel marine engines have gone into auxiliaries and main propulsion for mine sweepers. Cummins Diesels have been used for generator sets, for auxiliaries, and for Lend-Lease.

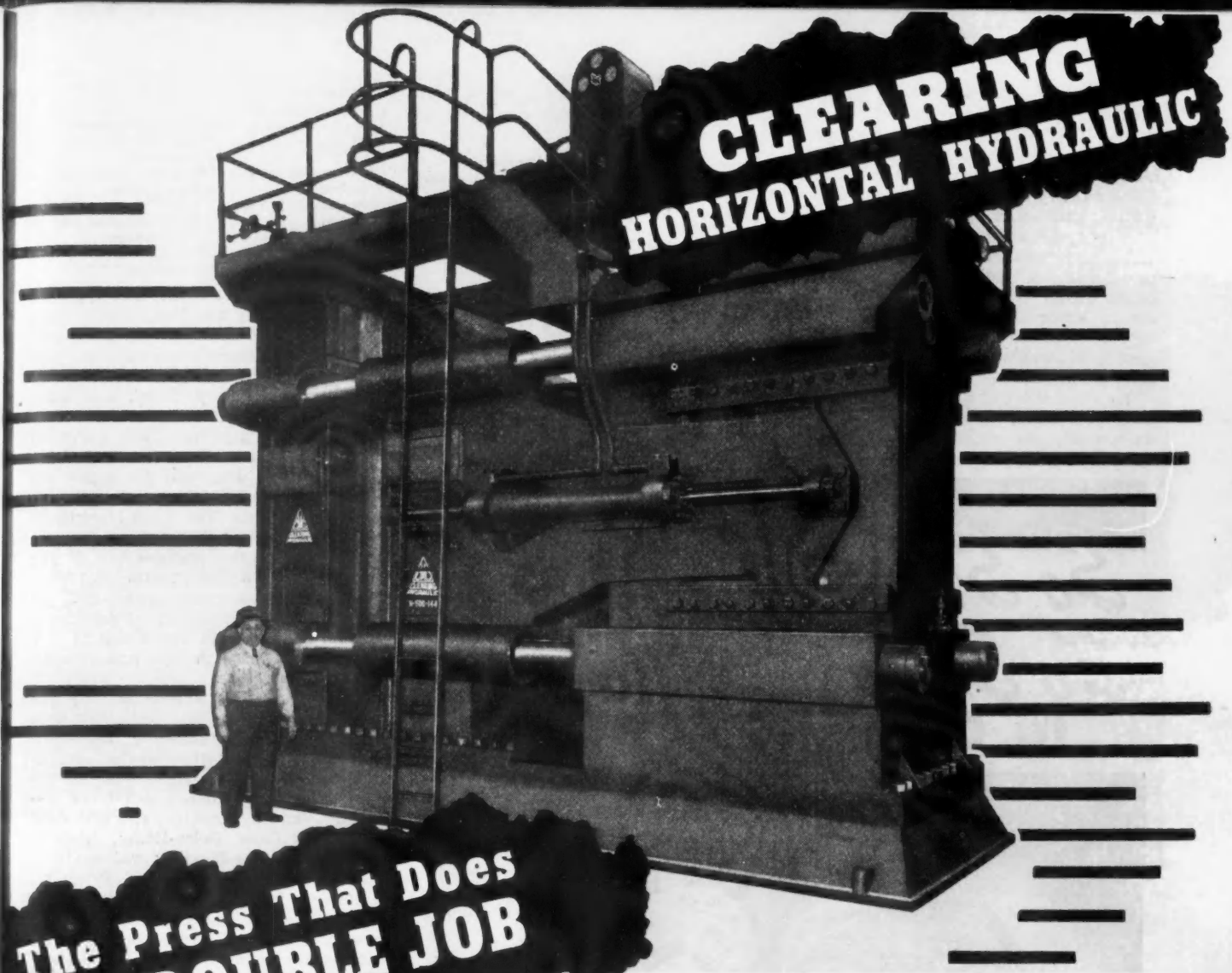
Fairbanks-Morse has produced a variety of models of Diesel engines for main propulsion for the LSM's, for submarines, and for various auxiliaries. Main propulsion Diesel engines were versions of the 10-cylinder O. P. type.

Cleveland Diesel engines have been employed as main propulsion for various combat vessels, including submarines; also as auxiliaries for many types of combat vessels as well as large landing craft.

Hall-Scott had been producing the well-known Invader (6-cyl. gasoline marine engine) before the Navy program became intensified and early in 1942 licensed Hudson Motor Car to produce Invader engines. This made it possible for Hall-Scott to concentrate upon the building of its Defender (12-cyl. V-type marine gasoline engine) for the early Picket Boats, and later primarily for Lend-Lease.

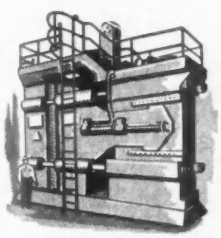
Hercules Motors Corp. is an important contributor of a variety of types of Diesel and gasoline engines for auxiliaries such as pumps, generators, air compressors, winches, etc. National Supply Co., Super Engine Div., has produced a number of models of





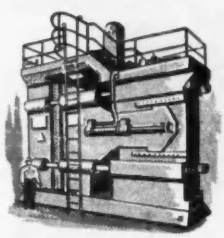
The Press That Does A DOUBLE JOB

More and more often Clearing engineers are assigned a problem in press design where meeting the requirements of a production work-handling sequence is as important as solving the technicalities of the work cycle itself. Perhaps there are places now on your own production line where a major improvement in a production step requires a new method of bringing the work to a machine.



Clearing engineers have repeatedly shown that problems like these do have a practical solution. The press above is one of many like it that do the double job of (1) performing a production operation and (2) fulfilling the requirements of a new between-machine handling sequence.

This particular press is a Clearing 500-ton horizontal hydraulic for use in the hot forming of hollow steel propeller blades. The horizontally moving ram closes on the work, and after the dies are closed, a compressed inert gas is admitted into the open end of the hollow blade; the compressed gas forces the walls of the blade against the die surfaces to form an accurately shaped propeller blade. This operation, due to the overall shape of the blade, causes an extremely eccentric distribution of pressure on the die surfaces. The dies, however, are held in exact parallel position by the unusual construction of the frame and double guided slide. The work cycle of the press is entirely automatic.



Typical of the way Clearing works is the design of this Clearing Horizontal Hydraulic to make possible a new and better method of bringing work to the press. Clearing engineers are experts at interpreting this thorough understanding of all phases of press practice in terms of your specific needs. Be sure to get their ideas and assistance when your production problems involve presses. Clearing Machine Corporation, 6499 West 65th Street, Chicago, 38, Illinois.

MECHANICAL AND HYDRAULIC PRESSES

for such operations as

DRAWING • BLANKING • FORMING • FORGING

CMC CLEARING

Diesel engines for some main propulsion but primarily for various auxiliaries. Sterling Engine Co. has completed large contracts for the Admiral 12-cyl. V-type marine engine; for the Viking heavy duty engine for the Coast Guard; and other types for main propulsion and for Lend-Lease.

In the general category of auxiliaries are found the contributions of Waukesha Motor Co., The Buda Co., Wisconsin Motor Corp., Willys, LeRoi, and others. A more complete listing of engine producers will be found in the accompanying table.

To show the distribution of automotive type engines more graphically, let us consider the major equipment of a sampling of large landing craft. On the LCI (L) the set-up has been as follows:

Detroit Diesel Quad	Main Propulsion
Detroit Diesel 2-71	20 KW Diesel generator sets
Chrysler T-118	Anchor Winches
Wisconsin	
Briggs & Stratton	Portable Fire Pumps

On the LCT (6):

Gray Marine-Detroit Diesel	Main Propulsion
Hill Diesel, National Supply, Hercules	10 KW Generator Sets
Hercules	Anchor Winch
Wisconsin	Ramp Winch
Johnson	Portable Fire Pump
Wisconsin	Ballast Pump

On the LST:

Cleveland Diesel	
Electro-Motive	Main Propulsion
National Supply	100 KW Diesel generators
Cleveland Diesel	Smoke Generators
Wisconsin	Fire Pumps
Hercules & DNX	Portable Fire Pumps
Johnson	Welding sets on Flagships
Chrysler	3½ Ton Crawler Cranes

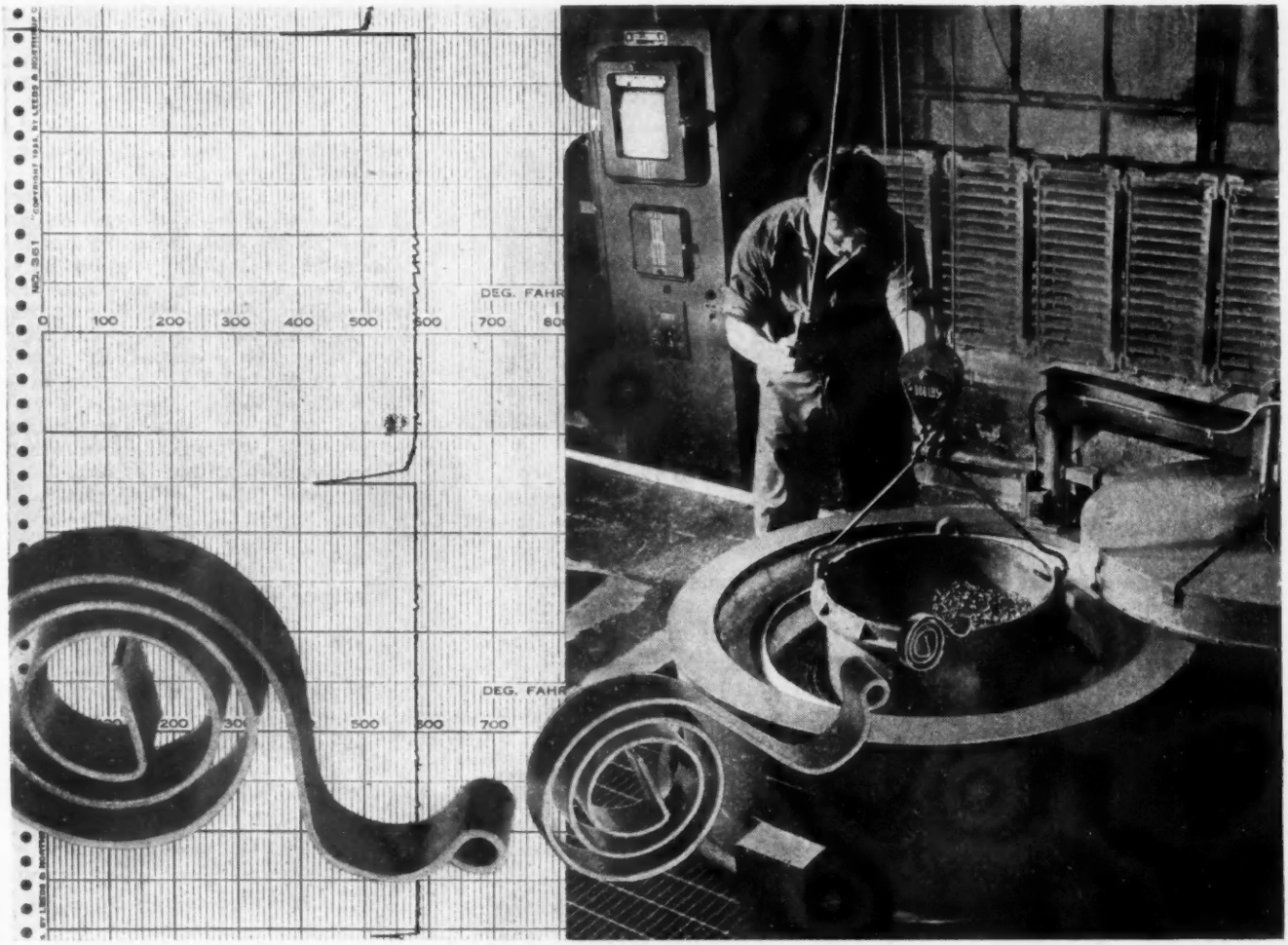
One of the most distinctive types of craft adopted by the Navy for landing operations was the versatile LVT amphibian, popularly known as the "Water Buffalo." It was developed by the Food Machinery Corp., and built by a number of sub-contractors, including Graham-Paige and the Ingersoll Steel Disc Div., Borg-Warner Corp. More recently, Ingersoll developed another type of LVT which is being built in its own plants. The Food Machinery version of the LVT uses the same power train as the original Army light tank, namely, a Continental air-cooled 9-cyl., radial, aircraft type tank engine with Spicer final drive; the Ingersoll version employs two Cadillac V-8 engines coupled with Hydramatic tank type transmissions.

But the finished engine is only the focal point for a widely radiating area of productive effort, leading into every channel of automotive parts production. Mechanical units such as reverse gear and clutches and transmissions; engine governors; electrical equipment from Delco-Remy, Electric Auto-Lite, Leece-Neville; valves from Wilcox-Rich, Thompson Products, Aluminum Industries and others; forgings, stampings, castings; instruments; raw materials of every variety. To detail these would be to produce a complete roll of the automotive industry.

Yes, the Navy is really in the automotive industry. And the speedy end of the war in the Pacific depends upon the industry's earnest cooperation.

Now to touch upon the magnitude of the problem. Fig. 1 is a chart showing the projected growth of Internal Combustion Engine use in our wartime Navy. Unmistakably it indicates the progressive acceleration of cumulative demand not only for engines but for spare parts. Although for security reasons the actual horsepower values are not shown, the relative values represent the true situation. No matter where V-E Day comes, this program must go according to plan.

A measure of the need for a constantly accelerated production of repair parts may be had from reference to the chart below. Using 100 as an index of the number of engines as of Dec. 31, 1943, which are a year or more old and consequently demand a supply of repair parts, the index as of the end of 1944 will be over 300 and, at the end of 1945, will be well over 500. Regardless of what the program may be, in the months to come, for the building of new engines, the demand for repair parts will be three times as great at the end of 1944 as it was at the beginning—and within another year it will be five times as great. The de-



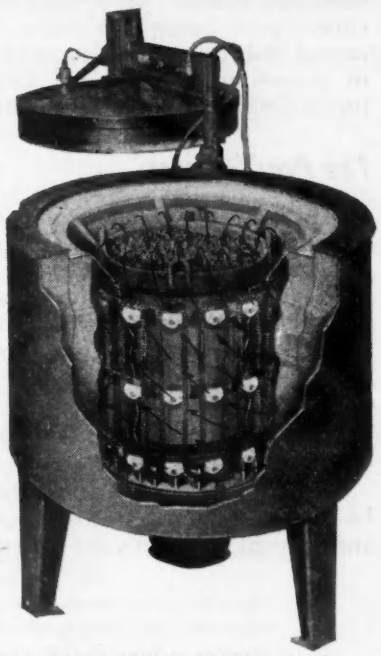
Accurate Spring Mfg. Co. of Chicago uses the Homo Method in precipitation-hardening of hundreds of types of springs made of beryllium copper. Chart shows accuracy of heating of two typical spring batches.

HOMO METHOD HELPS HEAT-TREAT SPRINGS OF BERYLLIUM COPPER

In the hardening of springs made of beryllium-copper, the Accurate Spring Mfg. Co. has found that the Homo Method is the sure way to rapid, precise and uniform heating required by this modern alloy. Homo quickly heats a batch of springs to exactly the desired temperature—which may be anywhere from 500 to 635 F. All springs in the batch reach the soak temperature with remarkable uniformity, and all are held at the required temperature, automatically, without overheating in some areas or falling away in others. No reject in the Accurate plant has ever been charged to Homo Method—and inspection is 100 per cent in some cases, because of the high standards of quality.

The Homo Method equipment used for this "precipitation hardening" of non-ferrous alloys is exactly the same as is used for tempering, normalizing, low-temperature annealing, spheriodizing and allied operations on steel parts. It's the modern form of the original, compact, fully-automatic Homo forced-convection method.

Homo is available in many sizes. If you have a heat-treatment problem requiring accurate or fast or dependable work, an L&N engineer will gladly talk it over with you, or send Catalog T-625, as you prefer.



Compact design puts electric heater, heating space and blower all in one unit; unique air circulation makes Homo the standard for meeting mass-production's uniformity requirements.

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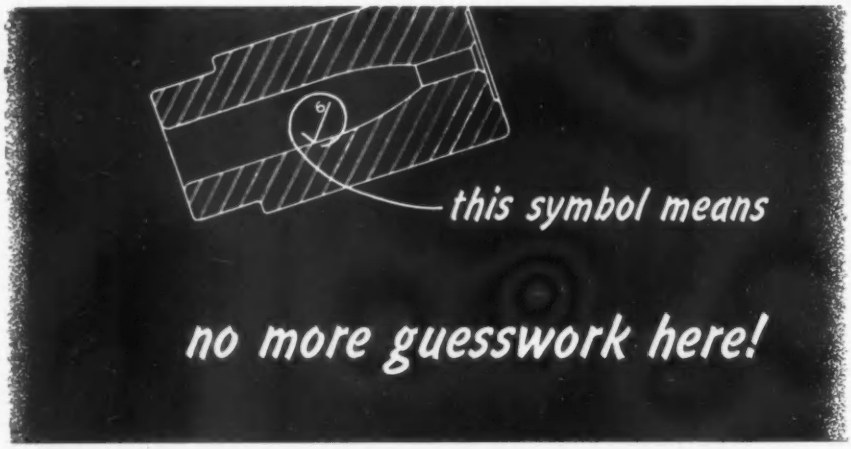

THE ENGINEER, by using this symbol (or one of its variations), is specifying a definite surface finish measured in microinches. He has eliminated the guesswork that for years went into production of satisfactory surface finishes.

The engineer need no longer rely on the designation "*f* = smooth machined surface . . . " which he knows may produce as many different surfaces as there are men in charge of making the part.

And in preparing his specifications, the engineer can call for the surface most suitable for the work the part has to do. Very close tolerances can be set for the production of very smooth surfaces—or of rough surfaces where a pre-defined roughness is wanted.

The Profilometer* has enabled the simple, accurate measurement of surface roughness—making possible the fullest use of the roughness symbol shown. With the Profilometer, each part may be accurately checked on a production basis to make sure it meets blueprint specifications for surface roughness.

Roughness control by means of Profilometer readings has facilitated finishing to dimensions, prevented waste of materials and time, and enabled production of better surfaces on millions of machined parts going into war machines. Wartime experience in this regard indicates extensive application of surface-roughness control in peacetime manufacture. Inquiries are invited from manufacturers looking ahead to peacetime production.

The Profilometer . . .

The basic Profilometer unit is a complete shop instrument for measuring average surface roughness. Nearly all surfaces can be measured with this unit. This unit is supplemented by standard accessories available in the form of extra Tracers, piloting fixtures, and other devices to facilitate production measuring on very smooth surfaces, odd-shaped surfaces, and in slots, grooves, small holes and on tapers.

Our Application Engineering Department is fully equipped for the design and manufacture of special jigs and fixtures where standard equipment is not adaptable.

To help you with your surface-roughness problems, we would be glad to demonstrate the Profilometer equipment in your plant and on your parts, at your convenience and at no obligation to you.

Quick deliveries can now be made on orders without priorities. The Profilometer Catalog contains data and information useful in planning postwar production and inspection—write for your copy.

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PHYSICISTS RESEARCH COMPANY
343 SOUTH MAIN STREET · ANN ARBOR, MICHIGAN

mand will continue to go upward as long as the fleet operates.

Criticism ofttimes has been voiced by laymen as well as engine builders of the volume of spare parts required by the Navy. The explanation for the realistic need is found in a brief exposition of the problem.

Naval warfare in the Pacific is fluid. It is a war of motion over vast expanses difficult to visualize. From the standpoint of logistics certain bases have been established and these are stocked with the necessary spare parts. But the fleet is on the move. Landing operations are projected to widely separated points. Thus, in addition to the bases of supply, there is a vast armada of supply ships in constant contact with the fleet. Repair vessels in the pipe line must carry parts. Each combat vessel and landing craft must

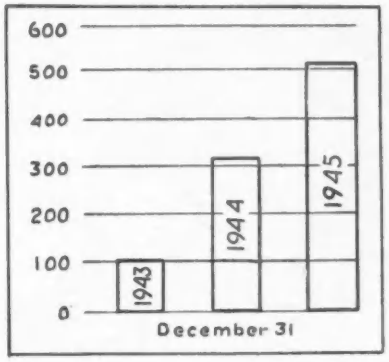


Fig. 1. The projected growth of internal combustion engines in our wartime Navy

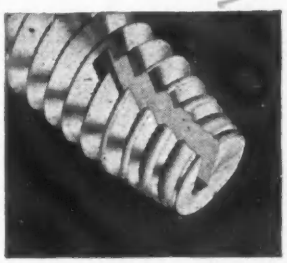
carry on board spares to safeguard its operation. A Navy ship at a dock or on the Pacific is impotent and prey to the enemy if a single bearing or a single fuel injector goes bad and a replacement is not on hand.

Another point. Suppose there is a movement of landing craft from the Mediterranean to the Pacific. It goes the hard way—the long way, across the Atlantic and into the Pacific. Just a single trip to a base in the Pacific may require overhaul—even though hurried—before leaving; and in all probability will require complete overhaul at the destination some 10,000 miles away before the vessel is fit for combat duty. When one considers that a marine engine, even in normal running, is subjected to wear and abuse far exceeding that of any type of road vehicle, it is easier to visualize the problem of maintenance under conditions of war—of intensive operation without rest, and of the unpredictable effects of the elements and battle damage.

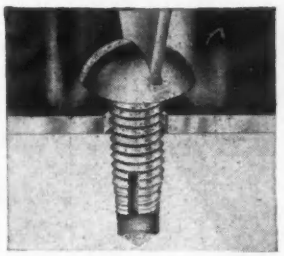
While faced with problems of reconversion to civilian production, so essential to the maintenance of our economy, it is nevertheless imperative to bear in mind that in certain areas of manufacturing there is still a scarcity of production facilities. Even now, the output of forgings and castings is far below requirements. And at this writing many engine builders

6 Important Reasons

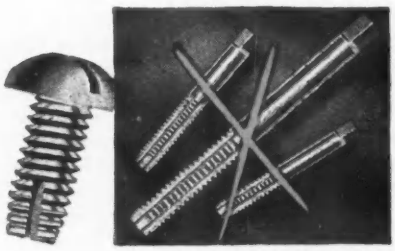
WHY YOU SHOULD USE SHAKEPROOF TYPE 1 THREAD-CUTTING SCREWS



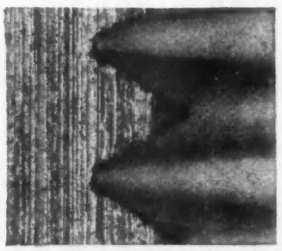
1 Exclusive Thread-Cutting slot provides sharp, serrated cutting edge.



2 As each Type 1 is driven, it cuts its own perfect mating thread.



3 Eliminates tapping—no taps to buy or maintain.

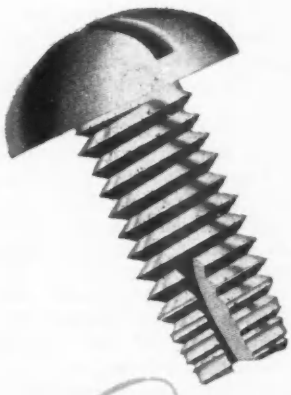


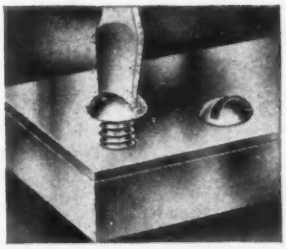
4 Snug, tight fit *always*, because each screw remains in the thread it has cut itself.

Plus THIS Specialized ENGINEERING SERVICE!

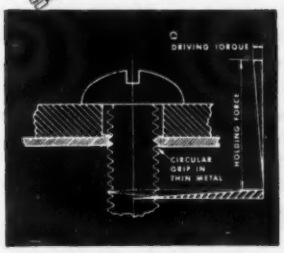
Through laboratory research and extensive field experience, Shakeproof engineers are in an excellent position to help you speed assembly, lower production costs and improve product performance. They thoroughly understand fastening problems and can recommend the type and method of fastening best suited to your particular product and to the requirements of your assembly line.

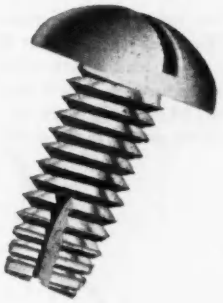
This Shakeproof Engineering Service is offered without obligation. Write today . . . a Shakeproof field engineer will contact you immediately!





5 Drives easily in any thickness of metal.





6 Maximum thread contact assured because of standard machine screw thread.

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Free Test Kit

Kit contains a variety of sizes and styles of Shakeproof Type 1 Thread-Cutting Screws. Write today for Kit No. 22!

have not begun to meet the spare parts needs of the Navy. It happens that the Navy's portion of the automotive industry's output is relatively small. It should not affect the orderly reconversion of industry, provided its requirements are met as a matter of MUST; it can interfere if not adequately met.

The fact is that the impact of the Navy program on the industry after V-E Day needs must have a stabilizing effect upon the independent engine producers and parts makers. In dollar volume, in employment, and in priority, it offers the stability which can carry producers through the period of readjustment that is to come.

It appears self-evident that in going all-out for the Navy—and that will be the Number One job after V-E Day—industry and labor as well as the general economy will profit by the stabilizing influence of the activity.

MANUFACTURERS SUPPLYING ENGINES TO THE NAVY

American Locomotive Co.
The Baldwin Locomotive Works
Briggs & Stratton Corp.
Buda Co.
Cadillac Division, General Motors Corp.
Caterpillar Tractor Co.
Chrysler Corp.
Cleveland Diesel Engine Division, General Motors Corp.
Continental Motors Corp.
The Cooper-Bessemer Corp.
Cummins Engine Co.
Detroit Diesel Engine Division, General Motors Corp.
D-N-X Engine Corp.
Electro-Motive Division General Motors Corp.
Evinrude Motors
Fairbanks-Morse & Co.
Gray Marine Motor Co.
Hall Scott Motor Car Co.
Hercules Motors Corp.
Hill Diesel Engine Co.
Hooven, Owens, Rentschler Co.
Hudson Motor Car Co.
International Harvester Co.
Johnson Motors
Le Roi Co.
National Supply Co.
Packard Motor Car Co.
Scripps Motor Co.
Sterling Engine Co.
Waukesha Motor Co.
Wisconsin Motor Corp.

Consolidated Vultee To Build Wind Tunnel

Plans for the construction at Lindbergh Field of an aeronautical laboratory, to include a wind tunnel and an air flow laboratory, have been announced by Consolidated Vultee Aircraft Corp. The new laboratory will be located on Pacific Highway just south of the main Consolidated Vultee plant buildings at San Diego, Calif. Models with wing spans up to 10 feet can be tested in the new tunnel, which will be constructed at a cost of $524,000. It will have a working section 8 ft by 12 ft in size and a maximum section of 20 ft by 30 ft. Wind velocities can be produced up to 350 mph.

The tunnel is a single-return, closed throat type with power provided by a variable speed motor which will absorb 2250 hp at its maximum speed of 250 rpm. The balance system was worked out by Convair's development engineering department in collaboration with Caltech experts and representatives of Baldwin Southwark. In addition to the wind tunnel, the new aeronautical laboratory will include an air flow laboratory for testing air ducts, a complete model shop and engineering office space. A control room, separated from the wind tunned test section by shatter-proof glass, will house the controls and instruments necessary for operation of the tunnel. Underneath the test section will be a room containing the special equipment for supporting models in the tunnel.

Construction of the laboratory has already started. Although the building is scheduled for completion in May and all equipment will be installed by August 1, 1945, it is not expected that the new facility will be in full operation for six months thereafter. The Austin Co. is contractor on the project, under T. W. VanDerveer, San Diego Division chief plant engineer.

The two packaging press "veterans" are similar in design and construction to the modern 3-and 4-Way NOPAK Hand Operated Valve shown in the circle.

Specify NOPAK for LONG VALVE LIFE

The two NOPAK ¼", 3-Way Air Valves on the packaging press shown above, have been in daily use for over ten years without a single day off for repairs or maintenance. After 10 years they are still leak-proof, show no visible signs of wear.

This is the kind of long term, maintenance-free operation you can expect from NOPAK Valves. It is the inevitable result of the patented cored-disc principle, hand-lapped, wear-proof disc and seat, shielded sealing surfaces, packless valve stem assembly . . . features which contribute to their simplified design and rugged construction.

You can specify NOPAK Air or Hydraulic Valves for the precision control of cylinder power movements in your plant, with absolute confidence in their dependability, long service-life and low maintenance costs.

Write for Bulletin 88

GALLAND-HENNING MFG. CO., 2774 S. 31st STREET, MILWAUKEE 7, WISCONSIN

Representatives in Principal Cities

NOPAK VALVES and CYLINDERS
DESIGNED for AIR or HYDRAULIC SERVICE

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Allegheny Stainless- Quickly from Stock

Ryerson stocks of Allegheny Stainless Steel include sheets, plates, bars, angles, tubing and pipe in a wide range of types, finishes and sizes. Facilities for cutting and otherwise preparing this stainless steel for your requirements are unsurpassed. All stocks and shipments are carefully protected against surface damage.

Allegheny was the first stainless steel made on a production basis. Experience gives it the highest rating for uniform high quality and workability.

Stainless steel stocks at Ryerson Plants have been greatly increased and quick shipment is assured. Service from each Ryerson Plant is supplemented by service from the other ten.

Technical bulletins on any type of Allegheny Stainless are available. Expert counsel from Ryerson engineers and metallurgists on any problem of stainless steel selection or fabrication is yours on request. Write your nearest plant.

Have you a Ryerson Stock List?—includes more than 10,000 kinds, shapes and sizes of steel.

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RYERSON STEEL

JOSEPH T. RYERSON & SON, INC. Steel-Service Plants at: Chicago, Milwaukee, St. Louis, Detroit, Boston, Cleveland, Cincinnati, Philadelphia, Buffalo, Jersey City, Pittsburgh.

Bars · Shapes · Plates · Sheets · Tubing · Structurals
Carbon and Alloy Steels · Tool Steel · Allegheny Stainless

Mack's Modern Production Methods

(*Continued from page* 31)

specifications in close cooperation with the supplying steel mills.

The majority of metal cutting operations on castings, and on steel blanks for gears and shafts are done with properly selected grades of well-known types of cemented-carbide tools. Not only does this practice greatly increase productivity and improve surface finish but it is effective in reducing the amount of equipment required for a given volume of product. According to the factory management, the use of cemented-carbide-tipped reamers has improved productivity phenomenally and has reduced time down for tool changes to a surprising degree.

Consider now some highspotting of manufacturing operations in various departments. The transmission gear plant presents a compact arrangement with self-contained specialized lines for families of similar types of gears and shafts. Generally speaking, all gear blanks and shafts are machined from forgings which are normalized and shot-blasted before delivery to the machine shops. Gear blanks are of two general types—those with a splined bore, and others with a plain hole. Splined bores are prepared by boring, then broaching, the spline being used for locating all subsequent operations. The gears with a plain bore—usually fitted with a bushing—are first bored, then mounted on suitable mandrels for locating succeeding operations.

Special form-cutting and the cutting of gears with interferences is done on Fellows gear shapers. The majority of gears are hobbed on Barber-Colman and G & E single-spindle hobbing machines in two operations—rough- and finish-hobbing. Gear blanks are machined on Bullard Mult-Au-Matics and Potter & Johnston 5-Day heavy duty turret lathes. All hobbed gears are shaved on Michigan finishing machines using rotary cutters.

The foregoing touches upon the procedure in the "green" department. Gears and shafts now are ready for heat treatment. They are copper-plated as necessary, carburized, hardened, drawn, and shot-blasted. It may be noted that American Wheelabrator Tumblast machines are employed exclusively for shot-blasting operations in this plant. From heat treatment, the gears and shafts are routed to the "hard" lines for grinding. Here, too, the work is functionalized by setting up two separate lines—one for bushed bores, the other for splined bores. Heald internal grinders are used for hole grinding. Fitchburg universal type grinders are used for finish-grinding splines. Final operation is the lapping of gears in pairs on various types of equipment including lapping machines supplied by Gleason, Michigan Tool, and some developed and built by Mack.

To supplement this generalized statement of activity, we have reproduced the routings for a typical helical gear and a countershaft. These provide complete details of the manufacturing procedures. It may be of interest at this point to mention several features of quality control. Gear teeth are held to limits of 0.0002-0.0003 in. for form and spacing; and 0.001-0.006 in. backlash for mating. Bores are held to a tolerance of 0.001 in.; center distance spacing is held to 0.002 in. tolerance.

Next major department is the rear axle gear shop, producing bull gears, spiral bevel gear sets, bevel gears, etc. Here will be found a large automatic screw machine department, a comprehensive Gleason department for the cutting of bevel gears and for producing spiral bevel gear sets on the latest types of Gleason generators. Among the many other items of equipment we can mention the Bullard Mult-Au-Matics, a large battery of LeBlond lathes for turning blanks, an unusual setup for cutting bull ring blanks on Gisholt Simplimatics. One of the most striking of the special operations is a setup on several LeBlond lathes for

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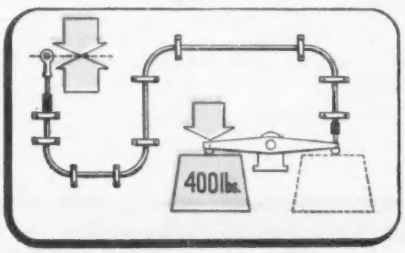
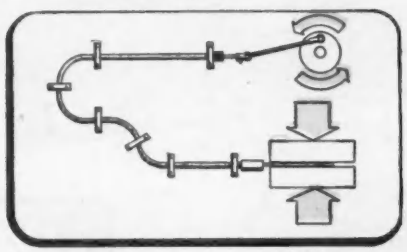
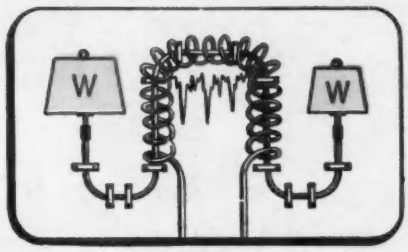
of Army Air Force Winterization acceptance for operation in extreme temperatures is the Simmonds-Corsey Push-Pull Control. Comprehensive tests with temperatures as low as minus 72°F. and as high as 160°F. prove efficient operation under wide variety of conditions.



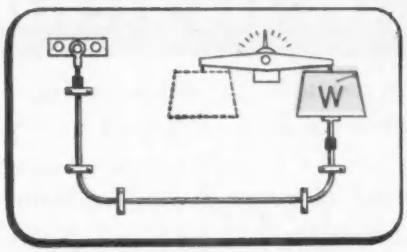
STATIC STRENGTH: *In this test Simmonds push-pull control successfully withstands tensile and compressive forces of 400 lbs. Credit simplification of design, improved linkage.*



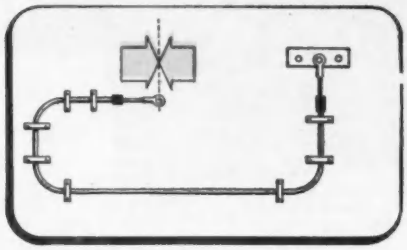
ENDURANCE: *Cycled 30,000 times under stress, as illustrated, Simmonds controls are not affected in any way, and can be expected to outlast the life of unit served.*



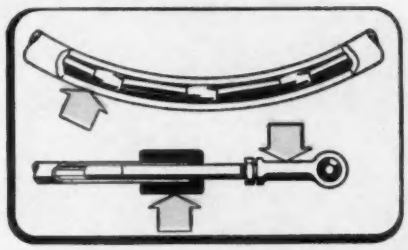
EFFICIENCY: *Input-output ratio of control is measured at various temperatures in insulated chamber. Result: average efficiencies are twice the AAF requirements.*



PRECISION CONTROL: *Motion between tension and compression is negligible. Before endurance test: average—.046"; after—.082". Simmonds are precision-built controls.*



DEFORMATION: *AAF specifications call for loads ranging from 10 to 50 lbs. Allowable average deformation is .140". Simmonds controls average only .083".*



CORROSION: *Simmonds controls meet AAF specifications for corrosion resistance with standard cadmium plated or anodized surfaces. Tube ends are rubber sealed.*

INQUIRIES concerning War Contracts or Post-War problems involving push-pull control equipment are invited. Our service engineers will furnish you gladly with analyses and recommendations. Telephone or write to your nearest Simmonds office.

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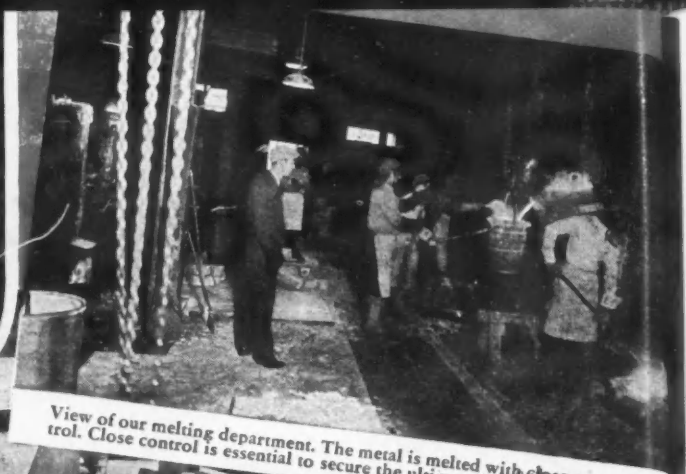
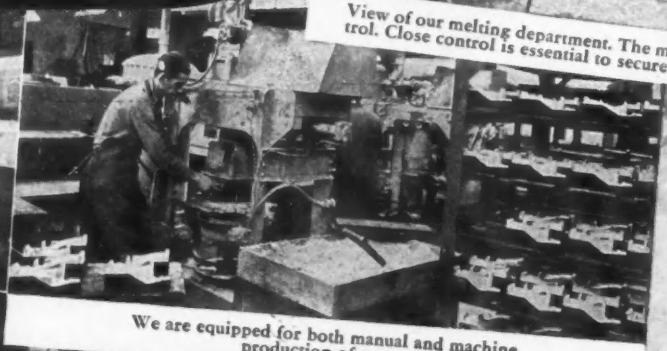
SAND CASTINGS

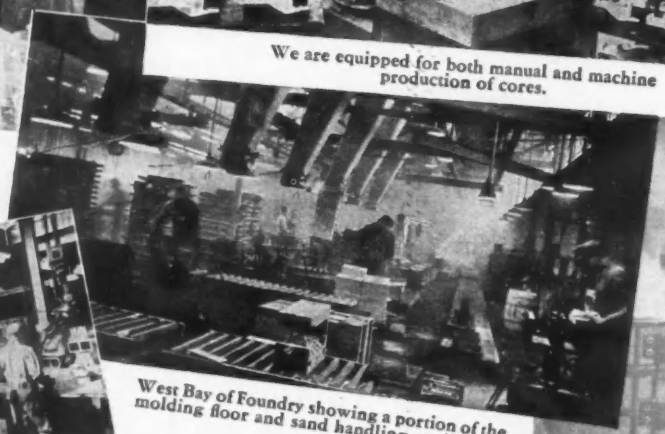


View of our melting department. The metal is melted with close pyrometer control. Close control is essential to secure the ultimate in physical properties.

A section of our well equipped laboratory where all heats undergo severest analysis.



We are equipped for both manual and machine production of cores.



West Bay of Foundry showing a portion of the molding floor and sand handling equipment.

A section of our cleaning department. Here operators perform the various jobs of burring and grinding castings to remove seams, parting lines and fins.

A view of our well-equipped heat treating department.

X-ray department where castings receive inspection for possible hidden flaws.

A section of our large machine shop. Every type of machine is available in this department for highest precision machining.

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COMPLETE FACILITIES FRO PATTERNS to LABORATORY—HEA TREATING AND MACHININ

Uniform results in magnesium castings are d pendent upon the physical equipment and perso nel of the foundry. Hills-McCanna are complete equipped for the production of magnesium cas ings. Our highly trained personnel, physical an chemical control, inspection and testing, all co tribute toward the utmost in quality, coupled wit dependable service.

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generating a multi-lobed internal bore, using a special cam attachment. The heat treating department serving the shop is equipped with modern Hagan pusher type furnaces. Certain of the gears are quenched on the familiar Gleason quenching machines. Some spru gears are shaved, other gears are finish-ground on Pratt & Whitney precision gear grinders, and other types of grinders used by Mack for many years.

Following heat treatment, axle gear sets are lapped and mated in Gleason machines; and spiral bevel sets tested for noise in the sound room. Blakeslee Niagara washing machines are used in various places for cleaning work. Magnaflux inspection is imposed on all highly stressed parts such as axle shafts, thrust washers, shifter shafts, etc.

The machining of transmission cases and differential carrier housings represents another major activity. This department is replete with Logan gravity roller conveyor lines for the transfer of parts from one operation to another. Cemented-carbide tools are used extensively on all operations including milling. One of the most striking pieces of equipment is the huge four-way W. F. & John Barnes horizontal boring machine tooled for differential carrier machining. Complete details of the machining of the large carrier will be found on the factory routing reproduced here.

The assembly department provides the final setting in this plant. Handling about four types of differential carriers and four different transmissions, the task has been skillfully developed on self-contained assembly lines. Each of these consists of a merry-go-round rail, carrying dollies which are moved progressively from one station to another. Each group has its own test station in the center, permitting the complete running-in of the unit within each group.

Owing to space limitations, the foregoing was limited to a brief perspective of the Mack gear plant with its multiplicity of manufacturing operations. Let us shift scene to the new foundry for a brief comment on some of its major features.

Easily the most impressive job here is the making of cylinder blocks for large engines. These blocks are intricately cored and require painstaking attention to detail. All castings are produced by dry sand core technique. Most noteworthy feature of quality control is the use of surface grinding and boring of cores. For example, the cylinder barrel cores are made in halves, each section being surface ground on the parting face to produce a smooth and perfect joint before pasting the halves together. Similarly the water jacket cores are bored with Carboloy-tipped tools for smoothness and dimensional accuracy. In setting the cylinder block cores, the molders use a variety of steel gages for establishing proper alignment. The combination of these procedures establishes this operation on a precision basis comparable with the best practice demanded of aircraft foundries.

The foundry is divided into two distinct sections—one for handling large castings such as cylinder blocks and heads; the other for a variety of smaller parts which are handled mechanically. Sand slingers are employed in several departments: for example, a huge machine is used for the molding of the cope and drag for cylinder blocks; another is used in the core room for making up cylinder block cores; smaller units are found on the several rotary molding lines.

The core room has a rotary line for making cylinder cores. It also features a DSM vertical core oven. Mathews gravity roller conveyors are used throughout.

Small castings are produced on continuous pouring lines, as distinguished from the floor molding and pouring of the larger cylinder block castings. The pouring conveyors loop around the department so as to communicate with the merry-go-round molding lines at various points. At the end of each pouring conveyor is a Simplicity shakeout station from which the castings are transported to the cleaning room. A Jeffrey conveyor line serves the shake-

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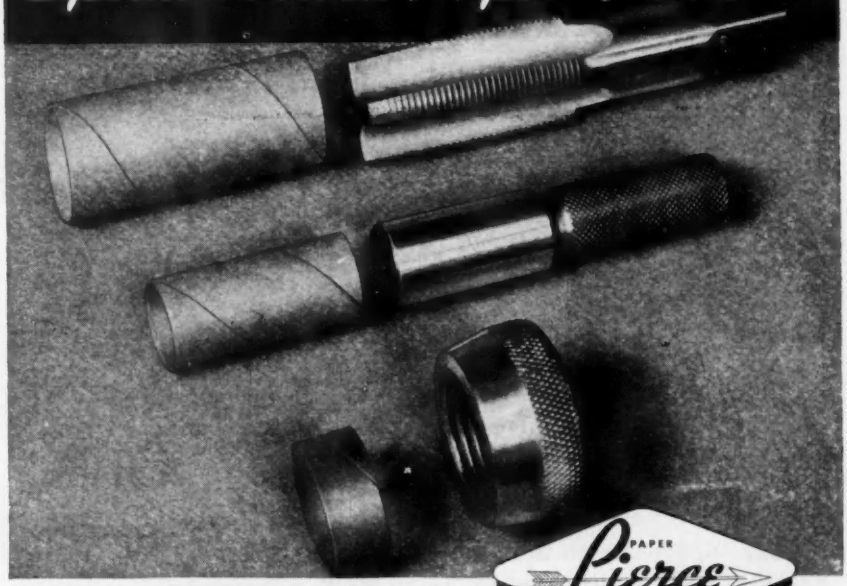

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Guard against damage in intra-plant handling or during shipment; save time and work in packing. For instance—as illustrated—many plants use paper tubes to protect parts that must be trucked from machine to machine or department to department between production operations. This is just one application; but it is typical of the many and varied uses for these tubes. Let us know *your* requirements. Tubes are made in diameters from ⅜" to 6"—any length—from kraft, chipboard, special compositions; available waxed or plain. Write for complete information; get details, too, on our other lines of paper tubes and cans.

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Industrial gaskets: manufactured to precision dimensions from paper, felt, cork, asbestos-synthetic rubber, leather or special compositions; meet specifications for resistance to oil, water, gasoline, heat, pressure. Die-cut products: produced by rotary press, platen press, punch press, or drawing methods from paper, felt, cork, special compositions.

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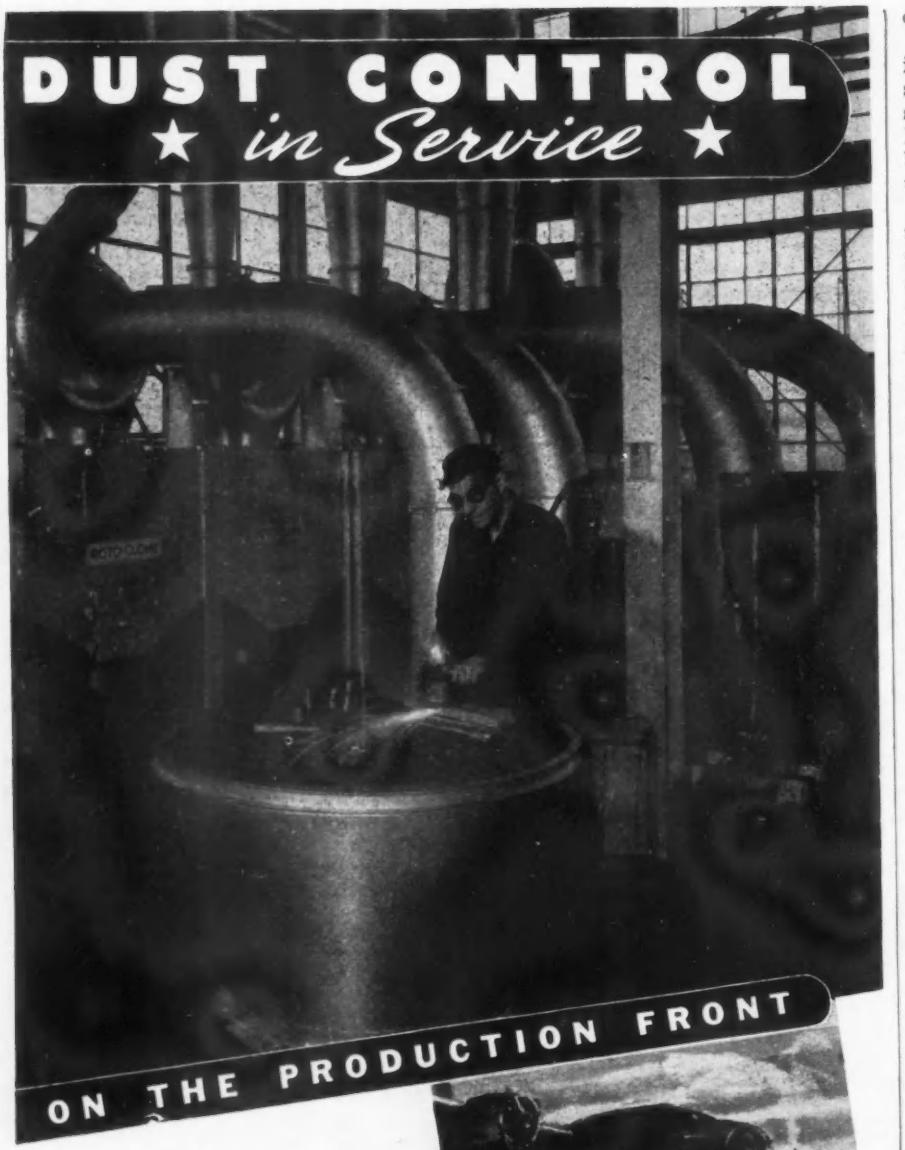

Production for war forever established the importance of adequate industrial dust control, and the return to peacetime manufacture will again emphasize its need.

Already, AAF engineers are planning dust control systems for companies whose post-peace plans are crystallized. It's not too early now to plan for V-Day production. May we help you? There is no obligation involved in bringing your anticipated dust problems to us today. Write for booklet, "AAF In Industry", which describes the complete line of AAF equipment for every dust control need.

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out stations.

Molding in the small castings section is done on rotary floor tables with a sand slinger in the center, using hand-stripping type molding machines. Foundry molding stations are served by a central sand conditioning and distribution system.

Following shake-out, all castings are shot-blasted in American Tumblast machines, then snagged and chipped and ground by hand to clean up thoroughly. Cylinder blocks and heads are water-tested in this department before acceptance. It is of interest to note that cylinder blocks are inspected in a huge target fixture to establish locating points which are used in positioning in production fixtures in the machine shop.

This completes a very quick survey of a major foundry and gear operation. The factory routings and pictorial section with its selection of views in various parts of the plant will give the reader some visualization of this plant and should provide a better appreciation of the background for the quality which has made Mack trucks a symbol of the best in their field.

Foamglas Output To Be Doubled

Pittsburgh Corning Corporation has announced plans to double the capacity of its Foamglas plant at Port Allegany, Pa., to meet rapidly increasing demands for cellular glass insulation, an entirely new material first put into commercial production less than two years ago. Additions to the factory will ultimately cost about $750,000.

Foamglas, so far produced in rigid slabs 12 in. by 18 in. and in various thicknesses, is a true glass which has been blown up or "cellulated" so that its volume is about 15 times that of ordinary glass. It has a closed-cell structure, there being some five million tiny sealed air pockets per cubic foot. It weighs 10 lb per cubic foot, about the same as cork.

Stimulate Enterprise—Create Jobs

(*Continued from page* 15)

strung by national policies that prevent the expansion of enterprise.

There is no ceiling on accomplishment. Our problem is to do those things that will enable us to capitalize the manifest opportunities that are before us. We must remove from the path of progress the obstacles that are continually being erected by one group or another. That is the problem we face in the post-war period. and that is the problem upon the solution of which rests further expansion of the economy, a higher standard of living, more jobs and more and better things for more people.—*From an address before the Investment Bankers Association.*

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Oil dripping from machine bearings leaves surfaces which immediately begin to collect dust. This grime detracts from the appearance of the machines and of the shop generally. It also results in damage to many products. Oil-slippery surfaces, furthermore present a safety hazard.

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66 YEARS MANUFACTURING QUALITY MECHANICAL LEATHER GOODS EXCLUSIVELY AND NOW SIRVENE SYNTHETIC PRODUCTS

PUBLICATIONS

(*Continued from page* 60)

Resistance Welding Electrodes and Alloys is the title of a new catalog issued by P. R. Mallory & Co., Inc. It lists the complete line of standard spot welding electrodes and water-cooled holders and a section is devoted to a listing of Do's and Dont's for improved resistance welding technique.*

The S. S. White Dental Mfg. Co. has issued a new **Flexible Shaft Handbook** containing information and engineering data about flexible shafts and their application.*

The Micro Switch Div., First Industrial Corp., has issued a new handbook which illustrates and describes over 500 heavy duty type **Micro Switches** and auxiliary devices for electrical controls in aircraft, automotive, marine, railway and heavy machinery.*

John S. Barnes Corp. has issued a new Bulletin, 301-U, which illustrates and describes its line of **hydraulic units.***

A revised and enlarged edition of **Holden Neutral Bath Folder,** No. 130, has been issued by the A. F. Holden, Co. It contains information on Natural Baths used for hardening and tempering and includes data on Holden Flow Heat Treatment and the new Speed Nitriding Process.*

The Youngstown Miller Co. has announced a new bulletin, YM-800, which describes the operation and features of its **Plastic Coaters.** *

Bulletin No. 44-1 published by Jones Motroia Co. describes four models of Jones individual **tachometers** and the Jones Multirange portable hand tachometer. It contains full-face and profile views of the individual tachometers, rpm ranges available, mounting dimensions and includes prices for tachometers and appurtenances, a section on use and operation and general installation data.*

* Obtainable by subscribers within the United States through Editorial Dept., AUTOMOTIVE *and* AVIATION INDUSTRIES. In making requests for any of these publications, be sure to give date of the issue in which the announcement appeared, your name and address, company connection and title.

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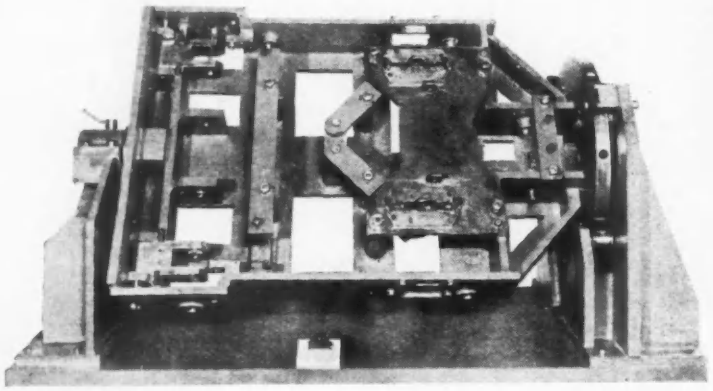

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Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* AUTOMOTIVE AND AVIATION INDUSTRIES**

Moderately increased general business activity is currently indicated. *The New York Times* index for the week ended Nov. 25 stands at 144.6, as against 142.3 for the preceding week and 147.2 a year ago.

Department store sales, as reported by the Federal Reserve Board, declined from 252 to 235 per cent of the 1935-39 average during the week ended Nov. 25. The indicated total is 17 per cent above that for the corresponding period last year, as against a rise of 13 per cent reported a week earlier. The aggregate figure for 1944 to date is 9 per cent above the comparable sum last year.

Railway freight loadings during the week ended Nov. 25 totaled 768,730 cars, 11.1 per cent below the figure for the preceding week and 6.2 per cent less than the number reported a year ago.

Electric power production declined moderately during the week ended Nov. 25 and remained below the corresponding level in 1943, showing a year-to-year decline of 0.8 per cent, as compared with a similar reduction of 1.4 per cent recorded in the preceding week.

Crude oil production in the same period averaged 4,736,000 barrels daily, 2850 barrels below the figure for the week before, but 15,500 barrels above the output recommended by the Petroleum Administration for War.

Production of bituminous coal during the week ended Nov. 18 is estimated at 12,180,000 net tons, substantially more than the output in the preceding week, which included a partial holiday, but 794,000 tons below that for the corresponding period in 1943. Total production so far in 1944 is 6.9 per cent above the comparable quantity last year.

Engineering construction contracts awarded during the week ended Nov. 30, according to *Engineering News-Record,* totaled $35,953,000, as against $23,189,000 in the preceding week and $52,181,000 a year ago. The total for the year to date is 44 per cent below the comparable sum in 1943, with a decline of 24 per cent in private construction accompanied by a drop of 48 per cent in public awards.

The Irving Fisher index of wholesale commodity prices for the week ended Dec. 1 stands at an all-time peak of 114.07 per cent of the 1926 average, as against 114.02 a week earlier and 111.35 a year ago.

Member bank reserve balances increased $42,000,000 during the week ended Nov. 29, with excess reserves rising $100,000,000 to an estimated total of $1,200,000,000. Aggregate loans and investments of reporting members increased $179,000,000 in the preceding week, although the total of commercial, industrial and agricultural loans declined $28,000,000.

Making broaches comes pretty close to being a *Fine Art*

There is no branch of tool making that requires as much actual first-hand experience as the design and manufacture of accurate and dependable broaches. Seemingly, negligible factors often result in large Differences in the effectiveness and the life of the broach. Very seldom are any two broach problems just alike and only the broach organization with wide experience is capable of evaluating all the factors which enter individual broaching problems.

For maximum economy and effectiveness, let such an organization supply your broaching tools.

What is thought to be the largest solid high speed steel gear tooth broach (893 lb.) ever produced.
IT CUTS 55 INTERNAL GEAR TEETH IN A COUPLING SLEEVE 48 TIMES FASTER WITH INCREASED ACCURACY AND CONSISTENCY THAN THESE TEETH WERE CUT BY THE PREVIOUS OPERATION

SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE

ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

MEMBER BROACHING TOOL INSTITUTE

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RED RING PRODUCTS

5600 ST. JEAN • DETROIT 13, MICH.

Fuel Injection for Aircraft Engines

(*Continued from page* 23)

supercharger, because the resulting lowering of the air temperature and increase in air density improve the supercharger performance. When a change to fuel injection is made, the supercharger design must be changed accordingly. Tests show that evaporation of the fuel in the induction air lowers the temperature about 40 F. With cylinder-head fuel injection, this drop in the induction-air temperature does not occur, and the supercharger performance is adversely affected. Fig. 9 shows that the Q/N value (cu ft of air per impeller revolution) is 6 per cent greater with injection than with a carburetor. Consequently, with a diffuser as used with carburetor engines, the pressure coefficient decreases 3 per cent when a change to fuel injection is made, but by installing a new diffuser with higher vanes, to handle the increased volume of air, the original pressure coefficient can be obtained. However, the effect of the higher vanes becomes noticeable only at relatively high supercharger capacities.

While a change in the supercharger diffuser can compensate for the loss in pressure coefficient, the air remains at a higher temperature through the supercharger, and inlet manifold temperatures run about 40 F higher with fuel injection. By itself this would result in a decrease in output of 6.5 per cent, but it is counteracted by the effect of fuel vaporization in the cylinder, and actually the full-throttle output of the fuel-injection engine is 2 to 4 per cent greater than that of the carburetor engine.

With injection directly into the cylinder, the best injection timing is determined by its effect on fuel evaporation, and as the latter factor controls both the output and the economy, the injection timing which gives the most power also gives the highest economy. For the Cyclone engine the optimum injection timing starts shortly after intake opening. Generally the maximum power remains substantially constant for the range of injection begin from 10 deg to 65 deg ATC and the thermal efficiency for the range from 15 deg BTC to 65 deg ATC.

Fig. 10 represents a comparison of the altitude performances of comparable fuel-injection and carburetor engines. At the particular engine speed to which the graph relates, the fuel-injection engine has a critical altitude approximately 600 ft higher than the carburetor engine, and at any given altitude the bhp of the former is 50 to 100 higher. The superior altitude performance of the injection engine is due not alone to the "tailored" supercharger, but also to the higher volumetric efficiency at higher speeds and manifold pressures. The improvement in the air-flow conditions when the carburetor fuel bar is removed from the induction passages also is responsible in part. Tests show that there may be as much as 1 in. of mercury column greater pressure drop across the carburetor than across the throttle body of a fuel-injection engine, at rated power and the critical altitude.

In carburetor engines backfires are of common occurrence, because the entire induction system from the carburetor on is filled with explosive mixture, and if the mixture in one cylinder happens to be unusually lean, combustion in it may continue throughout the exhaust stroke, so that when the intake valve opens the charge in the manifold is ignited. With fuel injection there is only air in the induction system, and the usual backfires are eliminated. The priming equipment still used with injection engines is the source of backfires during the starting period, but such backfires are rather rare, and it is believed that they will be entirely eliminated as more experience with injection equipment is gained.

Carburetor engines do not always respond to the throttle as well as might

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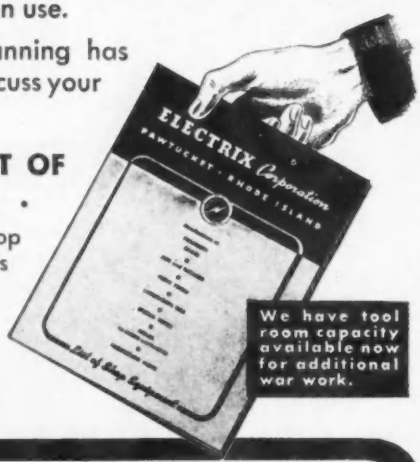
It lists and illustrates our machine-shop equipment, and pictures precision tools and parts we have made for war industries.



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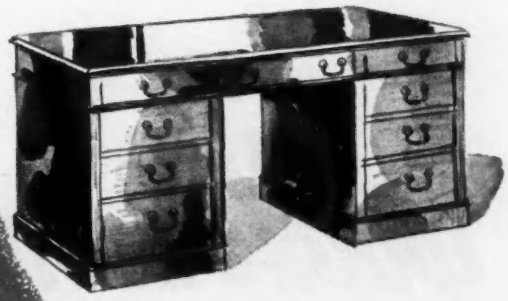

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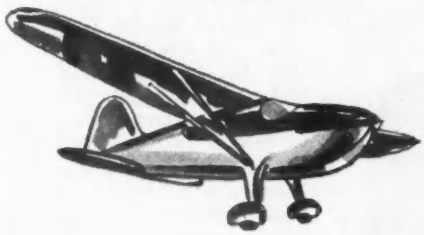

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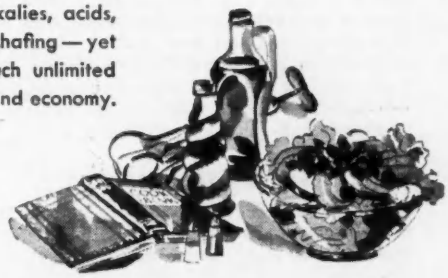

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be desired, though considerable improvement in this respect has been achieved in recent years. Fuel injection directly into the combustion chamber prevents a lag of fuel flow relative to the air flow, and backfires during acceleration are eliminated.

Injection-engines operate relatively smoothly. This would be expected because the power impulses are more nearly uniform. When cruising with a lean mixture, the stability of engine operation, due to more nearly uniform distribution, is very noticeable, and this smoother operation may reasonably be expected to result in reduced maintenance costs.

It appears that with fuel injection the alcohol de-icers or air-heating systems used with carburetor engines will not be required, though this still remains to be proved experimentally. Atmospheric or impact ice probably may occur in the fuel-injection engine, but the pilot usually is aware of this when it occurs, as ice then will form also on the wings. Such atmospheric ice is much less dangerous than "evaporation" ice, which occurs without warning.

Starting should be much easier with fuel injection, because the fuel is injected directly into the combustion chamber and cannot condense on cold manifold walls. A fuel-injection engine, when once started, usually continues to run, whereas a carburetor engine, when cold, may have to be started several times till the intake manifold is sufficiently warmed or wetted with fuel to provide adequate supplies to all cylinders.

During the period 1939-1941 considerable test work was done to determine engine performance on a safety fuel having a boiling range of 320 F-370 F. Starting and crankcase dilution are the two outstanding problems with this fuel that are still to be solved. The power and economy obtainable apparently are approximately the same as with volatile fuels of the same octane rating and heat value. Fuel-injection engines are less sensitive to fuel volatility, and with safety fuel the fire hazard would be practically as low as with Diesel engines. A spark-ignition, fuel-injection engine with a high compression ratio for economy, antidetonant injection for maximum power, and operating on fuel of low volatility for safety, apparently would compare favorably with the Diesel, while still retaining the desirable Otto-cycle characteristics.

Further experience is needed to accurately determine the types and sizes of engine with which appreciable improvements can logically be expected from fuel-injection equipment. As far as aircraft engines are concerned, the following are the pertinent facts:

1. Fuel injection may improve performance when applied to any engine in which the distribution is adversely affected by airplane operating conditions such as low intake-air temperature, high altitude, etc.

2. Engines of 1000 hp and over show all of the advantages of fuel-injection listed in this article to some degree. This applies particularly to engines with a high altitude rating, in which special effort is made to reduce losses in the induction passage. This inevitably means less turbulence, and therefore poor mixing of fuel and air in the carburetor engine. Large engines also are more beset with difficulties due to backfiring, poor starting, and unstable operation.

3. Fuel injection is mandatory if it is desired to use safety fuel.

4. For an accurate evaluation of the benefits to be derived from a change to fuel injection, the following factors must be studied: (a) Distribution under all airplane operating conditions; (b) cooling requirements, especially in relation to the probable airplane installations; (c) power output and altitude rating; (d) performance in conjunction with water injection.

After the potential gains due to fuel injection have been evaluated for a particular application, they must be weighed against the disadvantages of fuel injection, which include: (a) At present a fuel-injection engine weighs 50 lb more than a comparable carburetor engine, and the improvement in economy first of all must balance this initial-weight increase; (b) fuel

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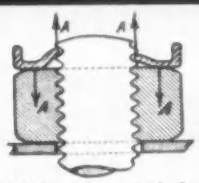
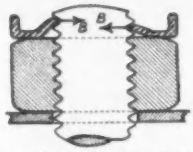


Arched, slotted spring steel jaws exert powerful tension upward on the bolt thread and downward on the regular nut.

2. GRIPS THE BOLT



At the same time, the jaws close in and grip the root of the bolt thread all around, like the jaws of a chuck.

Hold tight under severest vibration

With a regular nut carrying the load, and a PALNUT to keep it tight—you have a powerful fastening team that licks vibration, stress, heat and oil. Made of spring tempered steel, PALNUTS provide absolute security wherever bolted assemblies *must* stay tight . . . on structural members or engine parts.

Double-locking PALNUTS offer advantages over various types of locking devices . . . in security, in cost or in ease of assembly. PALNUTS are extremely low in cost, light in weight, require only 3 bolt threads space, apply speedily with hand or power drivers. May be re - used. Proved for over 15 years on every type of machinery and equipment.

WRITE for Palnut Manual No. 1 which gives complete details, engineering data, sizes, etc. Send details of assembly for samples and suggestions.

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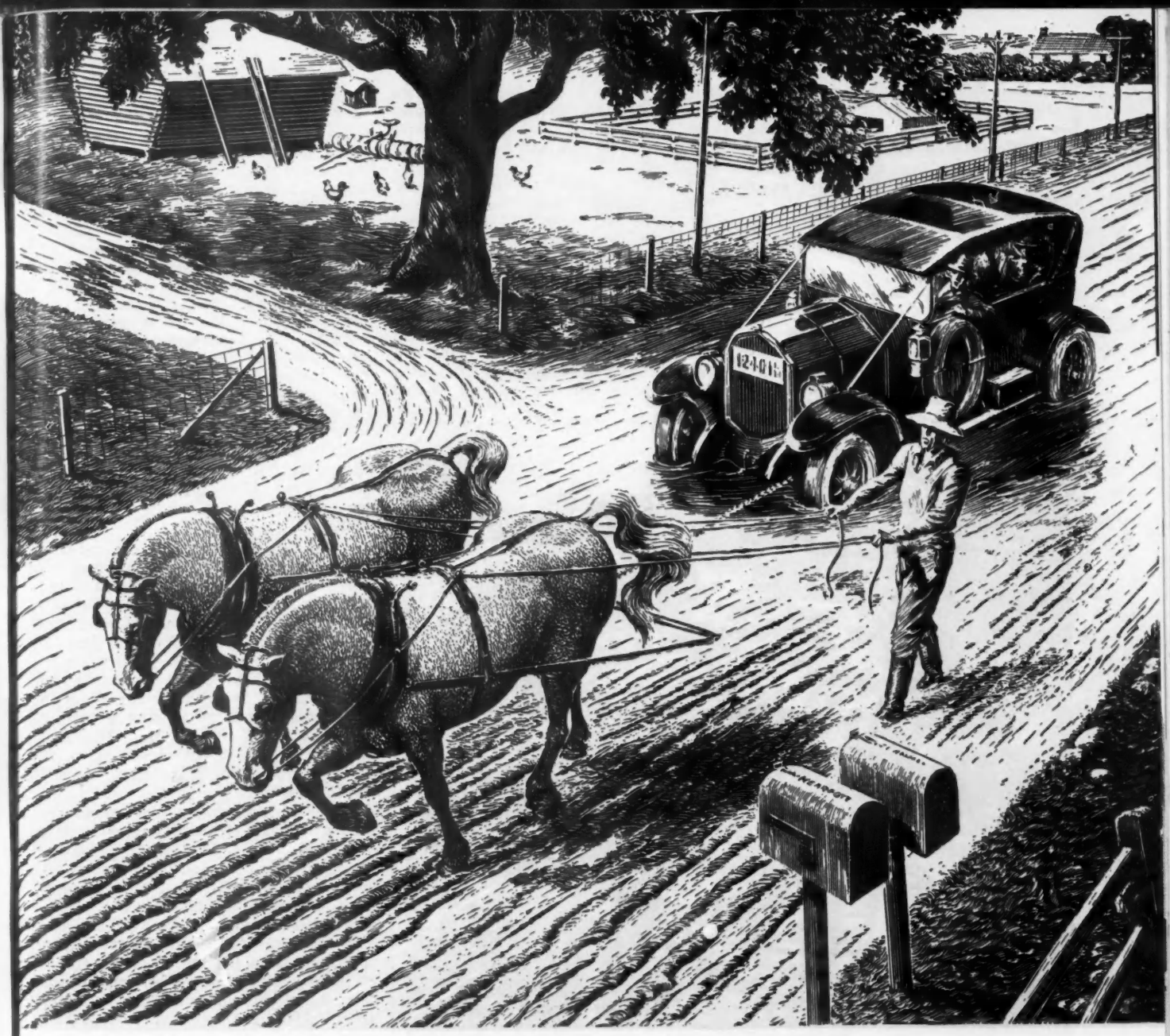

GOOD FOR TWENTY-FIVE DOLLARS ANY SUNDAY

• Farmer Jones could count on at least twenty-five extra dollars any summer Sunday in those good old days . . . hauling out the cars which, one by one, chugged and panted to a helpless standstill in the mudhole in front of his place.

But the cars which whiz along countless country highways nowadays are untroubled by mudholes, hills or rough going. Luxurious, dependable and safe, they are the products of an amazing quarter-century of automotive progress and of the initiative, vision and tremendous energy of the men in this youthful and dynamic industry.

The Eaton organization, by supplying mass-manufactured precision parts for many makes and models of cars, has done its best to contribute to that progress . . . to the development of the modern automobile and of the production methods which made it possible to build such *quality* into cars which rolled off the assembly lines by the hundreds or thousands every day.

The new knowledge and new techniques developed by Eaton in working with automotive and aircraft engineers during the war, have added greatly to the value of Eaton's thirty years' experience with these industries. After the war is completely won, everything that Eaton has in ability, experience and resources will again be devoted to peacetime progress in motor vehicles and aircraft.

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lines and fittings require trained personnel to insure correct installation, and careful maintenance is required to avoid line chafing and fuel leaks; (c) the initial cost is higher. This is almost inevitable, as there are more parts and more assembly operations. Maintenance cost on the fuel-metering equipment also is likely to be higher, for the same reason.

In December, 1930, tests were run at the Curtiss-Wright plant in Buffalo, N. Y., on a Challenger single-cylinder engine equipped with fuel-injection means. The equipment used included high- and low-pressure pumps, a hydraulically balanced nozzle, and a distributor valve. The tests indicated that in order to make the engine function satisfactorily on fuel oil with spark ignition, it would have to be redesigned.

In March, 1931, fuel-injection development was started on a regular Challenger engine of 185 hp at 2000 rpm. Two different injection equipments were used, one a Marvel three-plunger pump with distributor valve, the other an unconventional Ex-Cell-O system comprising a high-pressure pump and a distributor valve with a floating injection plunger. Tests run on California fighting-grade fuel with 10 per cent lubricating oil added showed that greater power and higher economy could be obtained with fuel injection than with carburetion. After some early difficulties had been overcome, the engine ran satisfactorily in July of that year.

During August, 1931, engine activities were transferred to the Wright Aeronautical plant in Paterson, N. J. Tests run there indicated that the Challenger engine with fuel injection had a minimum specific fuel consumption 5 per cent lower than that guaranteed with the carburetor engine of the same type. It had previously been found that some form of automatic fuel/air ratio control was necessary. Design of such a control system was started in April, 1931, and the system functioned satisfactorily in November of that year. At the completion of test-stand runs, the engine was installed in a Curtiss Robin plane and flight-tested.

Tests run on the ground showed that with kerosene as fuel—if warmed up on gasoline—the engine accelerated and idled as well as with gasoline, but under load it detonated excessively, and suffered from preignition and loss of power. At that time a hydrogenated safety fuel was made available by Standard Oil Co. of New Jersey. with an octane rating of 96 and a boiling range of 312 F-406 F. With this fuel the engine in ground tests operated satisfactorily after being first warmed up on gasoline.

Further development work was carried out on an R1820-F engine with a Wright-Ex-Cell-O injection system under a Navy contract. This system incorporated a high-pressure fuel pump with automatic control by the manifold pressure, and a suitable distributing valve, the fuel being injected into the combustion chambers. Tests started in May, 1933, and a 50-hr endurance test at 670 bhp was completed in June, 1933. After the injection system had been redesigned, another 50-hr test was completed, and the engine was installed in a Navy Hawk plane in May, 1934. After the usual ground run, the plane was taken aloft, climbed to 6000 ft, and was put through a series of maneuvers, during which the injection system functioned satisfactorily. During the latter part of the flight, however, the engine cut out completely, and an emergency landing had to be made. Examination showed that the injection-drive coupling had seized, as a result of dirt on the fuel-distributor rotor. The parts involved were redesigned, but a similar failure occurred during a flight test of an R1820-F2 engine installed in a BFC-2 plane, in January, 1935, whereupon tests with this type of fuel-injection equipment were dropped.

In 1936, under Army sponsorship, tests were run on an engine with intake-manifold injection, the equipment comprising a Marvel injection pump and low-pressure nozzles, and injection was controlled automatically by the inlet-manifold pressure. A 50-hr endurance test with this set-up was com-

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. . . YOU CAN OBTAIN 60% TO 80% OF YOUR CARBIDE REQUIREMENTS

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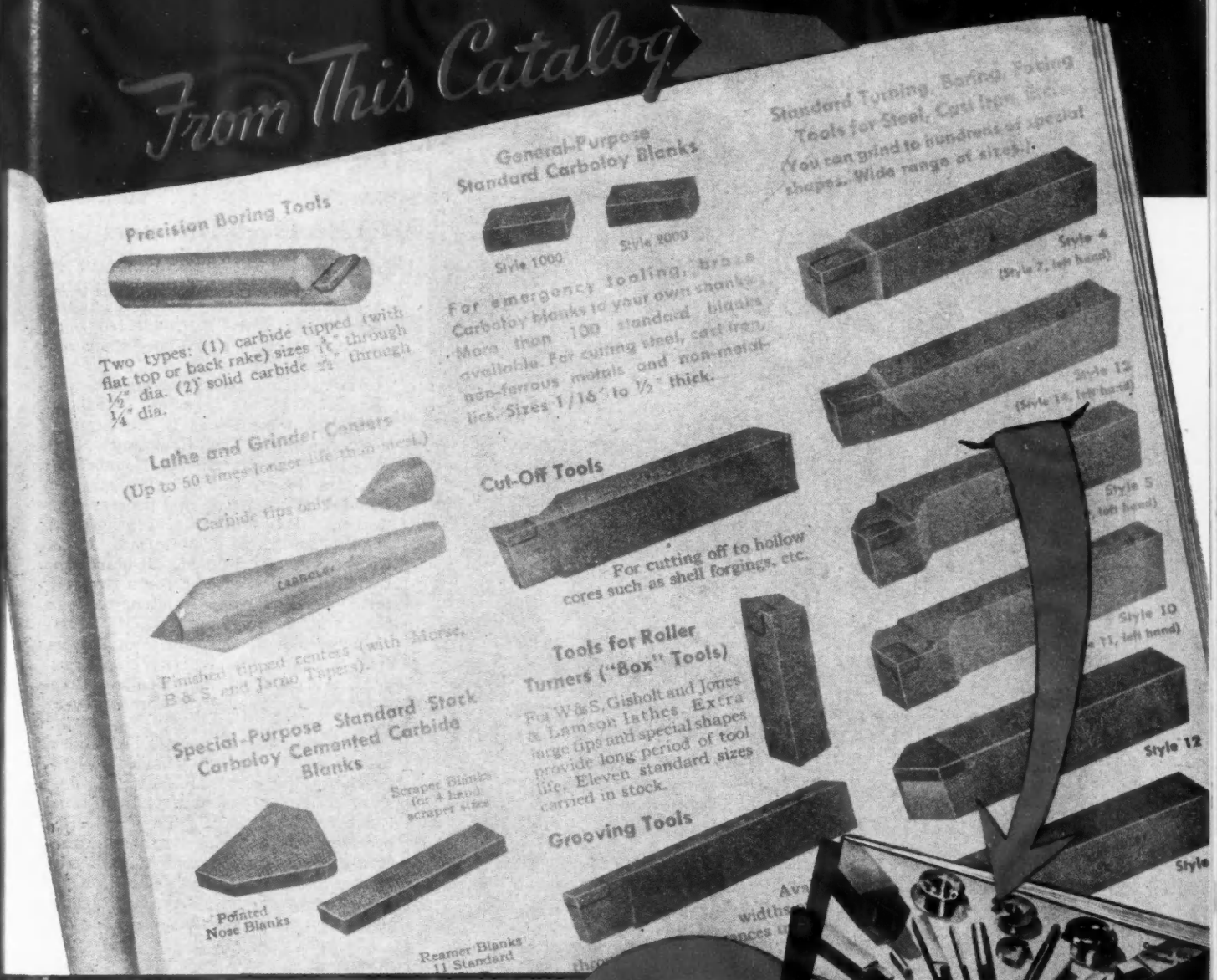
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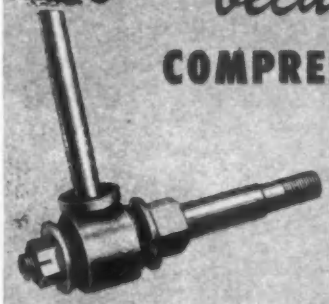

Jeeps are the "toughies" of all U. S. transportation units because most of their mileage is piled up on the rough, shell-scarred battlefields. They take a terrific amount of rough going but much of that is being smoothed out by Harris compressed rubber bearings for shock absorbers.

These Harris bearings permit freedom of motion in all directions, eliminating squeaks and rattles and prolonging the life of the shock absorbers. Regardless of which way the Jeep lunges, backward, forward, or sideways, the Harris rubber bearings help to control and cushion the motions in all directions, adding considerably to the stability, control, and operation of the car.

Harris Products Company are the originators of *Torflex* bearings, vibration eliminators, mountings, flexible couplings, and other vibration eliminator units.

The same creative engineering skill, experience and unsurpassed manufacturing facilities that produce these units will be available to industry at large when peace is declared.

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Duflex VIBRATION INSULATORS (MOUNTS)
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HARRIS COMPRESSED RUBBER BEARINGS

pleted in July, 1936. Another engine of the same type was equipped with an Eclipse injection pump with the Eclipse automatic control, fuel being injected into the cylinder heads. In 37 this engine was shipped to TWA for installation in a Northop Gamma plane for high altitude flight tests. It was flown approximatley 300 hr on both gasoline and safety fuel.

An aditional experimental program was initiated in 1938, in cooperation with the Navy.

CTMA Elects Directors

Completing the first year of its existence, the Cutting Tool Manufacturers Association at its first annual meeting on Nov. 17 re-elected eight former directors and added four new directors to the list.

Among the directors re-elected were W. G. Robbins, president, Carboloy Company, Inc.; Oscar L. Bard, president, Michigan Tool Company; R. G. Michell, president, Eclipse Counterbore Co., and George L. Buffington, superintendent of estimating and process engineering, Ex-Cell-O Corporation; all elected for three-year terms. E. A. Goddard, vice-president, Goddard and Goddard, was re-elected for a two-year term, while Norman Lawton, partner, Star Cutter Company; R. M. Severance, president, Severance Industries, Inc., Saginaw, and R. H. Wolfe, president, Arrow Tool and Reamer Company, were re-elected for one-year terms.

New directors include G. W. Frick, manager, Firthite Division, Firth-Sterling Company, McKeesport, Pa.; Emil Gairing, president, Gairing Tool Company, and G. E. Sheldrick, Sr., president, Midwest Tool and Manufacturing Company, elected to two-year terms, and D. E. Van Deusen, Kelly Reamer Company, Cleveland, Ohio, elected for a one-year term.

Bendix Division Output 12 Million Units

Nearly 12 million units of precision aircraft equipment have been produced for allied air forces since Pearl Harbor by the Eclipse-Pioneer Division of Bendix Aviation Corporation.

In the first public disclosure of the tremendous unit output it was pointed out that more than half the units delivered to the army and navy since the Japs bombed Pearl Harbor have been in new and improved products. These include new developments in engine starters, high-speed generators, compasses and other flight, engine and navigational instruments.

A widespread program of sub-contracting which enlisted the cooperation of large and small manufacturers early in the defense emergency has helped make possible the mass-production records achieved by the division in three years of war.

Inside story of a fighting gadget

It's not much larger than a hand. You can see that. But this little machine has a big responsibility and packs a lot more than a fistful of wallop.

Its job is moving flaps and shutters on America's fighting planes. It has to be powerful. It has to be light. It has to be compact and super-dependable.

Making it was a big order. The way Lear did it was through sheer engineering ingenuity and almost unheard-of precision in production.

Today this Lear Actuator and the tiny, powerful electric motor that runs it are fighting gadgets. But in the days ahead there should be many important applications for such devices.

So we tell you about them now. Then you will know that such things are available as well as the kind of engineering thinking and production technique that made them possible.

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LEAR
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The Failure of German Bureaucracy In France and Subsequent Chaos

(*Continued from page* 19)

Some surprise is expressed that confiscation should have been decided on before a public inquiry was made and it is maintained that Renault was condemned without having been given a hearing. A campaign for the nationalization of the Renault works has been conducted for some time, but confiscation appears to have come as a surprise—an agreeable one for the communist party.

Price control as practised by the Germans during the time they held France in subjection also was a complete failure. National socialism had decreed that the State should decide how much the worker should be paid, how much profit the manufacturer should take, and at what price he should sell his goods to the consumer. When the consumer was the German army, this plan doubtless could be carried into effect, and the Reich paid to French automobile manufacturers just as much as she thought trucks and other automotive equipment was worth. But when the general public was the consumer, the scheme failed to work. If the official price was too low, the goods went on the black market and no amount of threat, or punishment, was able to stamp out this method of trading. Decree followed decree until there was such a mass of regulations that the administration machine became inoperative under them.

There was not much of a problem in connection with new trucks and passenger cars, for the number of these which the makers were allowed to deliver to the general public was exceedingly small. In 1941 French civilian services got 12,358 motor vehicles, of which about 15 per cent were passenger cars; in 1942 the number had dropped to 5412, of which 8 per cent were passenger cars, and in 1943 the civilians were given only 2198 vehicles, and of these 1 per cent were passenger cars. In 1944 the number was nil.

It was recognized that some increase in motor vehicle prices was legitimate, and in 1941 an increase of 47 per cent on prewar prices was authorized for trucks, 25 per cent for agricultural machinery and 18 per cent for agricultural tractors. In 1944 there was an increase to 55 per cent for trucks. After the opening of the Russian campaign horses became valuable to the German army, and the purchasing price of these animals was increased 500 per cent.

Because of the very limited output from the factories, new truck and car prices did not create much of a problem. It was different, however, with used vehicles. The law of October, 1940, stated that the maximum price of used trucks should not be more than 47 per cent of that of the same vehicle in September, 1939. Later it was decreed that the price of a used vehicle should not be more than 90 per cent that of the same model new.

The State had a certain number of motor vehicles to put on the market by auction, and this created immediate difficulties. Despite all the restrictions —permits to purchase, permits to operate, permits to buy gas, tires, etc.— the demand was great and prices soared far ahead of the limits set by law. For a time the bidding was stopped when the maximum was attained, and the actual purchaser was decided by the drawing of lots among those who had bidden the maximum figure. The result was that the lucky purchaser immediately sold his truck at two or three times the purchase price.

To avoid this it was decreed that bidding should be allowed to go beyond the maximum, but the excess should go to the State. As the State was almost invariably the seller, this meant that the law on maximum prices was ignored. The dealer, however, who sold a vehicle above the maximum price laid himself open to punishment.

From chemical laboratories have come the materials which Acadia processes into synthetic rubber.

Combining special properties of their own—such as resistance to air, light, ozone, age, petroleum, etc.—with those found in natural rubber, Acadia Synthetic Products come to you in molded, cut or extruded form. Shaped to the closest tolerances, Acadia Synthetics are widely used in American aircraft.

If you have any problem involving the possible use of Acadia Synthetics, don't hesitate to call upon Acadia's engineers. They are prepared to help you. Write us today.

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Sealed with PRESSTITE SEALING COMPOUNDS

Many a tale has been told of the great work being accomplished by the Navy's PB2Y's—known as "Coronado" Patrol Bombers—in jobs ranging from bombing missions to heroic surface rescues. The fuel tanks of the Navy transport version of this type of plane, designated PB2Y-3R, are resealed by the Rohr Aircraft Corp. of Chula Vista, California.

Integral Fuel Tanks in these giant ships, the largest mass-produced plane in Navy service, are sealed with Presstite sealing materials using the Rohr Tank Seal Process. This method of sealing integral tanks, developed by Rohr Aircraft Corp., using these proven Presstite materials, represents the latest development in sealing tanks in large transport, cargo, and similar type planes.

Meeting the complex sealing requirements of the aircraft industry is only one example of Presstite's ability to originate and develop sealing compounds for specific requirements.

If your product or your manufacturing processes call for sealing or coating compounds, send your requirements to sealing specialists. We'll gladly work with you and your engineers in suggesting the most effective compounds to fit your needs.

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Plus Many Special Products for the Army and Navy

Our Engineering, Technical, and Laboratory facilities are at the service of any industry with a sealing problem.

Obviously the black market flourished.

Prices increased most for small economical passenger cars and for all types of trucks. At the same time there was a very marked increase in the price of lightweight motorcycles and in push bicycles. Large and medium sized passenger cars were not in very great demand. One popular make of two-seater which sold at 12,000 francs at the beginning of the war, rose to 50,000 francs second hand and is still bringing this figure. Another model, selling new at 21,000 francs, is changing hands used, but in good condition, at 100,000 francs.

Trucks of from 3- to 4-ton capacity sold by auction at 250,000 to 350,000 francs, but 500,000 was not an uncommon figure for the heavy duty models, and, before the Germans went, one million francs could be obtained for a heavy truck in good condition and well equipped with tires. There were cases where trucks sold by auction without engines, transmissions, wheels or tires attained the maximum price allowed for vehicles in good mechanical condition.

Tires were very extensively dealt in on the black market. As early as 1940 the Germans made the statement that "the supply of rubber is at the basis of all automobile programs, for at the present time rubber is the rarest of all raw materials necessary for car production." At that time no tire factories had been bombed. Before the middle of 1944 all had been put out of action with the exception of three of the smaller producers.

In 1941 a decree was issued that all tires should be declared to the authorities and arrangements were made for their purchase. As an inducement an increase of 20 per cent over the tariff was offered for tires given up immediately and the promise made that after the war sellers would be put on the priority list for new tires. At the end of 1941 the buying and selling of tires, except through Government offices, were forbidden. This, it is hardly necessary to say, did not in any way lessen the number of transactions. Certain sizes in great demand for trucks rose as high as 77,000 francs each, which was about the price of a 3-ton truck in prewar days.

The price of gasoline was held down to about 9 francs a liter and underwent little change throughout the war. This was easy, for by 1944 practically no gasoline was given out for private use. On the black market gasoline—doubtless stolen from German organizations—cost 100 francs per liter. Similarly maximum prices were fixed for gas oil (which disappeared from the market entirely), for alcohol, wood, charcoal, town gas, electricity, soft and hard coal and coke. Electricity and gas became unattainable, while wood and charcoal producer gas plants had to be increased 300 per cent and forced on the market under threats, while the black market price rose to 600 per cent of the original rates.

Aluminum Forgings all the way up to 8'6" propeller blade. The development of Aluminum Forgings by Wyman-Gordon for the war will give to post-war industry new production impetus through less weight, plus forging strength.
Wyman-Gordon
Forgings—Laboratory Controlled
WORCESTER MASSACHUSETTS
HARVEY, ILLINOIS
DETROIT, MICHIGAN

Goodrich Mud-Snow Tire

This mud-snow tire, made by the B. F. Goodrich Company, Akron, Ohio, is said to be the first new-design passenger car tire marketed by a major rubber company since Pearl Harbor. The tread has been engineered to impart maximum traction on slippery or muddy roads while still rolling smoothly on hard improved highways

HANSEN *Couplings*

PACE PRODUCTION IN THE GREAT LOCKHEED PLANT!

The remarkable production records made in the great Lockheed plant are something to be proud of because here is peak production at low operating expense. ● Hansen couplings used throughout the Lockheed plant are a very important factor in piling up production records on the great Lockheed Lightning and the giant transport Constellation. ● With Hansen couplings it's speed, ease of operation, no wastage of time and no leakage which means a big savings in air. ● Hansen couplings are easy to operate; slight push of plug into socket, coupling is connected, air is automatically turned on. Easy pull on sleeve, coupling is disconnected, air is automatically turned off. No twisting, turning or locking; no kinking of hose and no jamming or freezing of parts. ● Hansen couplings are the most widely used couplings on the market due to their vastly superior performance and long life.

Write for free industrial catalog.

HANSEN MANUFACTURING CO.

1786 EAST 27th STREET • CLEVELAND, OHIO

New Products

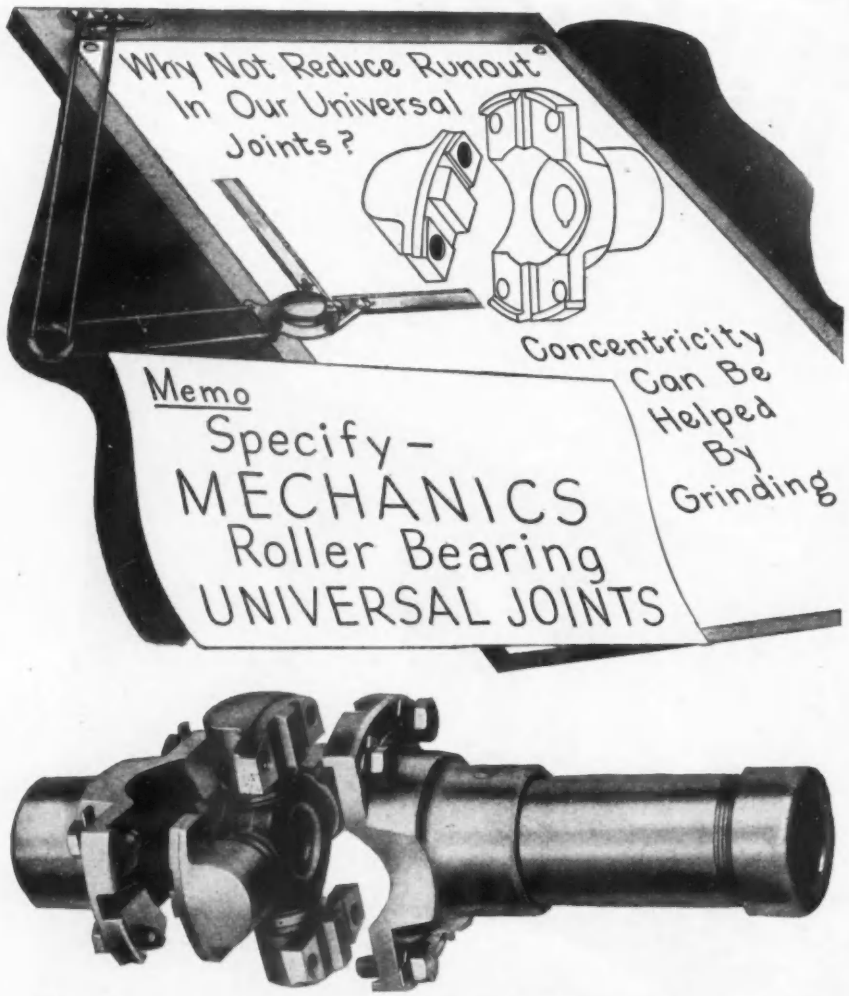
(*Continued from page* 44)

and diffusion of the rays that are lethal to air-borne bacteria. The unit may be recessed into the wall, or wall or ceiling suspended.

New Precipitation Hardening Alloy

A precipitation hardening alloy having exceptional uniformity in response to heat treatment has been developed by the W. M. Chace Company, Detroit, Mich. This alloy has a nominal chemical analysis of 60 per cent copper, 20 per cent nickel, and 20 per cent manganese, and is designated as their No. 720 manganese alloy. Although the alloy is more than half copper, it has a silvery color and presents an attractive surface when polished. It is corrosion resistant, and in this respect does not differ greatly from the familiar cupronickels.

The alloy is a soft, ductile metal which can be either hot or cold formed into intricate shapes and then hardened by a comparatively low temperature aging treatment. A hardness of 400 Vickers can be obtained by aging either dead soft or cold worked material. The physical properties corresponding to this hardness are: tensile strength, 200,000 psi; yield stress for 0.1 per cent offset, 170,000 psi; and a proportional limit of 120,000 psi. High freedom from "drift" and high fatigue strength make the alloy especially useful as a spring material.



If you specify MECHANICS Roller Bearing UNIVERSAL JOINTS for your new and improved models — you will reduce runout to a minimum. The pilot in MECHANICS joints is ground to fit into the corresponding pilot in the yokes. Yokes are turned from the bore, thus maintaining concentricity. Our engineers are ready to show you how this and other MECHANICS advantages will benefit your products.

MECHANICS

MECHANICS UNIVERSAL JOINT DIVISION
Borg-Warner Corporation
2020 Harrison Avenue, Rockford, Ill. Detroit Office, 7-234 G. M. Bldg.

New Principle in Rayon Tire Construction

The United States Rubber Company, New York, N. Y., has released information on a new principle in rayon tire construction which is said to provide stronger synthetic rubber truck tires and assure greater tire production.

Known as the "2200 denier" rayon type, the new development consists of using stronger but fewer plies in the tire. The new construction greatly reduces serious blow-outs which formerly placed a tire beyond the possibility of repair.

The 2200 denier rayon tire has twice the number of filaments twisted together as the 1100 denier which was the standard type previously used in conventional tires, and which the 2200 denier now replaces in certain sizes of tires. Due to the greater strength of the heavier rayon, tires built of the 2200 denier are stronger than those built of the lighter 1100 denier. As a result, blow-outs are reduced to a minimum. Further, the stronger individual rayon cords reduce rupture spread, thus making it possible to repair injured tires by recapping.

Presstico Spot Weld Sealer Now Made in Three Types

The Presstite Engineering Company, St. Louis, Mo., is now making three types of Presstico spot weld sealer. These sealing compounds, which are made to give a seal between plates that are spot welded together, are produced as flow gun, brush or spray type.

The manufacturer states that tests have been made using a 3½-in. by 10-in. by 10-in. box made by spot welding all seams at 3-in. pitch, using Presstico sealer in the joints and the box being then filled with water. Sample lap joints were made up, X-rayed and then sheared into tensile specimens. Other panels using the same joint were run through the paint system with or without bonderizing and left in a salt spray for two weeks. All specimens tested for a tensile strength to 2600 lb. X-ray showed all good welds and the box did not leak throughout the two weeks of test. The sealing compound stood up satisfactorily in the salt spray test. Spot welded panels, put through the

PENNSALT CLEANER

REG. U. S. PAT. OFF.

HELPS INDUSTRY RECLAIM STEEL DRUMS

CUTTING CLEANING COSTS 33⅓%

MANY MANUFACTURERS are faced with the urgent wartime necessity of reclaiming and re-using metal containers. The demand is for a cleaner that will do a *thorough* job —do it *fast*—and keep costs *down*.

A prominent oil refiner found the answer in a Pennsalt Cleaner.

The problem was to remove various types of oil, grease and solvents from steel drums—and to strip paint from these containers. The operation was carried on continuously in a 1000-gallon drum washer at 145 to 155 degrees Fahrenheit.

Several kinds of commercial cleaners had been tried previously, but cleaning was not satisfactory, rejects ran too high and costs were out of line. The method in practice was the use of an initial charge of 400 pounds of cleaning compound, followed later by an additional 300 pounds.

The Pennsalt representative was able to improve greatly on this with the correct type of Pennsalt Cleaner. The amount required was only about 35% of the previous cleaner. The cleaning action was highly effective —the drums dried faster—and grease containers could be included in the cleaning operation, an advantage not previously possible.

What's more—*careful comparison of costs showed that Pennsalt Cleaner was saving this plant 33⅓ percent!*

That's a saving that should interest you, if your plant has a metal cleaning problem. Let our experienced technical staff show *you* how a Pennsalt Cleaner will help you get better results at lower costs. Or write fully to our Special Chemicals Division, Dept. AA.

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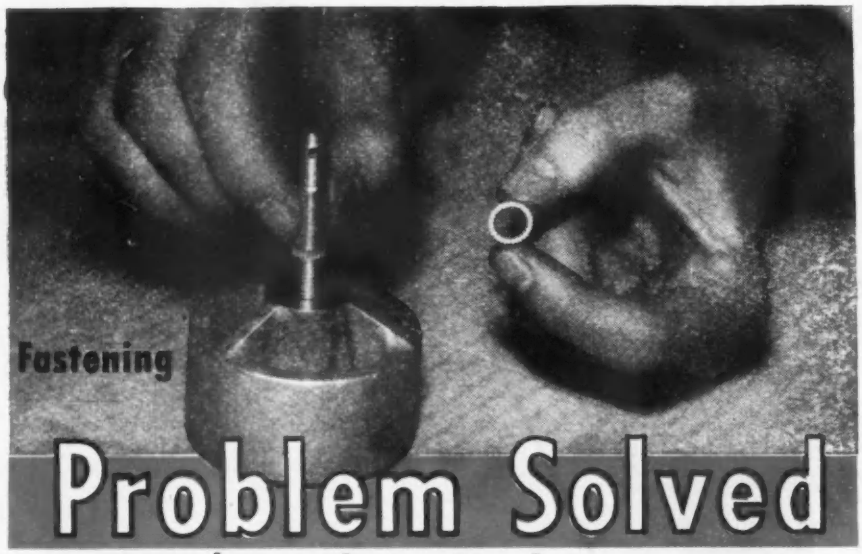


Problem Solved

By Rosán Lock-in-Studs

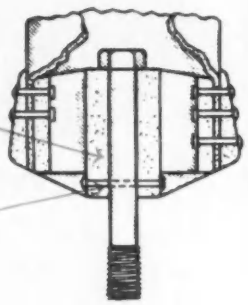
ROSÁN

U. S. and Foreign Pats. Pend.

CASE HISTORY

THIS BOLT ● was provided on a cast aluminum attaching plug which was riveted in the lower end of a rudder assembly torque tube on a Glenn L. Martin Company plane. The bolt acted as a pivoting point for the rudder hinge, and passed from the plug through a ball bearing retained in a hinge fitting, which in turn was bolted in the tail of the plane. For proper adjustment, the inner race of the ball bearing was seated firmly against the lower surface of the cast plug by drawing up a castle nut. Because the bolt head was inaccessible (inside the torque tube and above the plug) this rivet ● was provided to prevent the bolt from turning during adjustment. Unable to withstand tightening torque, the rivet sometimes sheared during the last few turns of the nut.

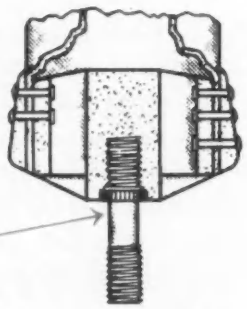
When the bolt turned freely, there was no way to hold the inaccessible bolt head. As a result, in subsequent servicing or replacement of the rudder, the bolt was in danger of being pushed up out of reach inside the torque tube. In that case a teardown of the assembly which included the removal of 19 rivets was necessary



Rivet failed in shear.

THE PROBLEM

To substitute an attaching stud for the bolt. The stud had to be installed in a blind hole in this plug, and locked in against turning under the torque of drawing up the castle nut.



Stud provides tight union.

SOLUTION

A Rosán Lock-in-Stud ● used in the hinge assembly not only provided a more solid attachment point for the bearing, than was possible with a rivêted bolt, but it facilitated assembly. The fact that the Rosán Stud could be quickly replaced in the same hole without disturbing the parent material was also a time saving feature in case servicing was required.

Rosán Lock-in-Serts and Lock-in-Studs are the solution to innumerable fastening problems in all types of industry. New applications for these fastening units are being developed and tested regularly in our engineering department. Manufacturers are invited to submit their problems. No obligation.

Rosán Lock-in-Serts and Lock-in-Studs have been adopted as a commercial standard by Glenn L. Martin Company. Photographs and technical description shown by courtesy Glenn L. Martin Company.

Write for free literature on Rosán Lock-in-Serts and Lock-in-Studs.

3

A PRODUCT OF

BARDWELL & McALISTER, INC.

EXCLUSIVE LICENSEE

DEPT. 12-124, BOX 1310, HOLLYWOOD 28, CALIF.

complete bonderizing cycle, including a three-minute dip at 210 F. in 2.5 per cent caustic potash, revealed no deleterous effect on the material in the seam. The material itself has no corrosive effect on metals.

Special Phenol Fibre

Taylor Fibre Company, Norristown, Pa., is offering a special type of phenol fibre which, when heated to within a few degrees of the blister point, can be permanently re-set in various shapes by pressing in wooden molds.

This new material, named Phenolastic fibre, is essentially fabric base phenol fibre as it has always been made, but with the added advantage of greater elasticity, obtained by a special weave in the base material of the fibre and rearrangement of the resin formula and coating procedures. Starting with a flat sheet of Phenolastic fibre, it is possible, within three minutes or less, to change the shape of the fibre to conform with almost any bend, curve, or draw desired.

Highly Sensitive Pressure Gages

New spring and bellows actuated pressure gages that measure ranges between zero and five inches, and zero and 50 inches of water, are being made available for industry by the Brown Instrument Company, Philadelphia, Pa. Two types of gauges are being introduced, according to the Brown Company announcement. One gauge has a single spring for pressure ranges. The other has a second spring, in tandem with the first, for vacuum and compound ranges.

The new models are said to be suitable for many applications. These include combustion pressures and steel, petroleum, chemical and aviation engine manufacturing, processing and testing.

Molding Compound Withstands Temperature Variations

A phenolic molding compound, specially formulated for use where temperature variations occur frequently, as in automotive ignition parts—distributors, rotors, coil tops, etc.—has just been placed on the market by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y. This material, designated as Durez 12708 Natural, is a mineral-filled phenolic which is said to have a very low mold-shrinkage factor, thereby making it particularly adaptable for use in parts which require metal inserts. This low shrinkage is claimed to reduce stress around the inserts, and render the finished part less susceptible to cracking. It is said that this new molding material may be easily preformed.

Engineered VACDRAULIC

Feather Touch Stopability!

FOR THE CARS AND TRUCKS OF TOMORROW

Automotive Engineers recognize that the introduction of power braking is essential to Post-War safety because driving habits and traffic problems are in for a change.

Smooth, quick, safe stopability, controlled by light pedal pressure, is a feature any driver appreciates because he — or she — can "feel" its action at every stop.

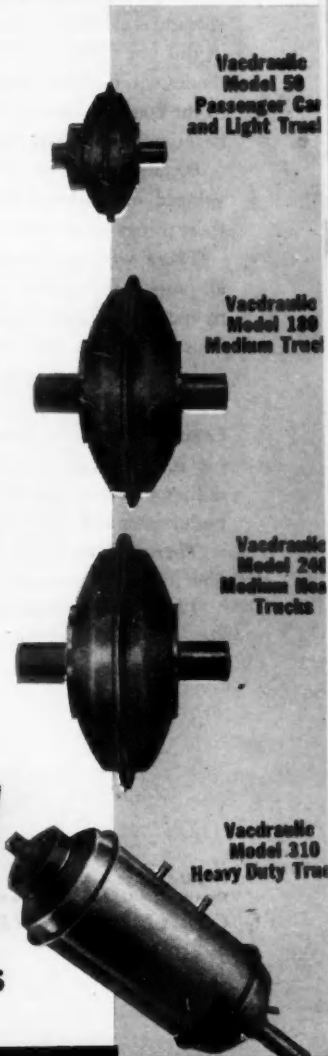
On new cars it is a "must"—yet those now on the road can also enjoy this feather touch stopability.

Vacdraulic — the power braking booster — is an engineered, proven, and dependable unit. It gives any hydraulic brake system the step-up necessary to bring the vehicle to a quick, smooth stop.

Vacdraulic accomplishes it without brake action lag and without rods or links. The few moving parts and little friction result in long life without adjustments.

* * *

May we send you complete details? EMPIRE ELECTRIC BRAKE COMPANY, Newark 7, New Jersey.



VACDRAULIC

THE BRAKE POWER BOOSTER

EMPIRE PRODUCTS INCLUDE:

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(Advertisement)

Synthetics...

and your Home of Tomorrow

THE "BIGGEST BUSINESS" in the nation is housekeeping. It goes on day in and day out in millions of homes, hotels and other public as well as private establishments. Housekeeping is indeed a gigantic "industry." And in this one category alone, Celanese* Synthetics will make tremendous contributions to the comfort, convenience, economy and beauty of living quarters.

Because special properties have been developed in synthetic textiles and plastics, these things are possible:

There will be slip covers, curtains and all-purpose fabrics with what is referred to by the scientists as "dimensional stability." This means that the everlasting remaking and lengthening of curtains and coverings after laundering will be a thing of the past. Celanese* synthetic yarns make this possible. It will add up to savings of millions of dollars and millions of hours of labor in both homes and public buildings.

There will be drapery materials entirely new in their decorative possibilities.

There will be upholstery fabrics more cleanable than ever before.

There will be shower curtains that will shed water like a duck—that will not stick or crack—that will be highly resistant to mildew and fungi.

There will be floor coverings luxurious in appearance but easy to clean.

There will be comforters with great warmth and beauty but extremely light weight.

There will be plastic lighting fixtures affording every range of delicate color—that will neither chip nor fade and that can readily be cleaned with a damp cloth.

There will be vacuum cleaners and other household appliances which will take advantage of the toughness and light weight of Lumarith* plastics. Their new appearance will last longer because of the surface permanence and clear-through color of these plastics.

There will be refrigerator parts and builders' hardware, colorful or transparent, which will never tarnish because they are made of modern plastics.

There will be colorful moldings around rooms which will furnish almost continuous plug-in outlets for electric attachments.

There will be attractive bathroom fixtures low enough in cost to be "expendable" when the urge for redecorating captures the household.

Of course these and the many other aids to convenient living that synthetics will provide cannot be fully available until the nation's machines that make synthetics into products run again on peacetime goods. But of all materials, synthetics are in best position to speed reconversion. They will have no conversion problems of their own. As textiles, plastics, or chemicals—Celanese Synthetics will be ready to furnish materials with pre-determined properties and desired advantages to be fashioned into finished products by the craftsmen of each industry, from floor coverings to cutlery.

Celanese Corporation of America, 180 Madison Avenue, New York 16, N. Y.

Celanese*

TEXTILES
PLASTICS
CHEMICALS

*Reg. U. S. Pat. Off.

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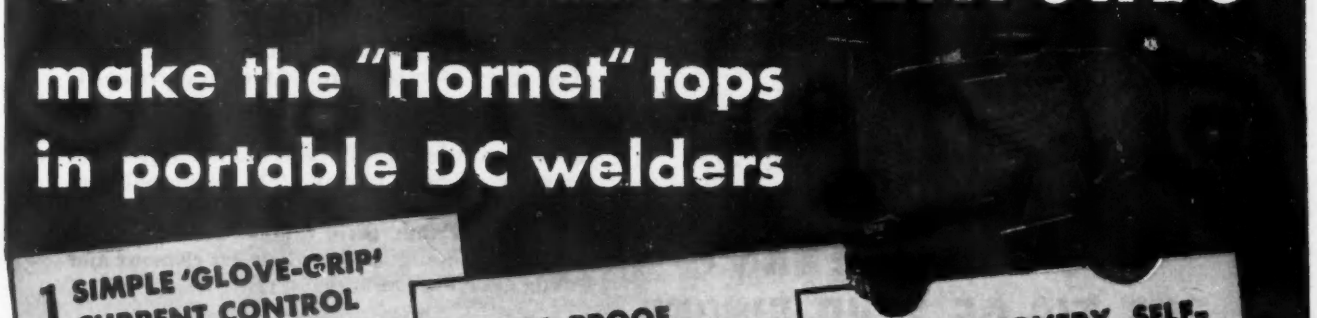
CELANESE CORPORATION OF AMERICA · 180 MADISON AVENUE · NEW YORK 16, N. Y.

3 WORK-SPEEDING FEATURES

make the "Hornet" tops in portable DC welders



1 SIMPLE 'GLOVE-GRIP' CURRENT CONTROL

All current regulation over the "Hornet's" wide welding range is centralized in one convenient, easy-grip hand wheel. Accurately calibrated dial covers "high" and "low" ranges for infinite current settings.

2 FOOL-PROOF POLARITY CONTROL

Only by flicking this switch can polarity be changed from straight to reversed, or vice versa. Accidental polarity reversal is impossible on the "Hornet".

3 FAST RECOVERY, SELF-CONTAINED EXCITER

Extremely fast recovery far exceeding Navy requirements. Simplest, most efficient means of self-excitation is employed on the "Hornet". This close-up shows rectifier and starter.

FAMOUS FOR ITS *Penetrating "Stinger"*

AND THESE OTHER IMPORTANT FEATURES

Throughout industry many important features of the "Hornet" have made it a widespread choice among operators. With its deep penetrating arc and excellent arc characteristics, it has earned the title—"the machine that makes the arc behave". • It starts easily...quickly • has "split-second" recovery • no sticking or "pop-outs" • and has unusually low spatter loss. • It's streamlined in design and easily portable. • All "live" parts are completely shielded.

The "Hornet" is made in 200, 300, and 400 ampere sizes. For complete details call or write any Air Reduction office, or mail coupon for illustrated catalog.

★ BUY UNITED STATES WAR BONDS ★

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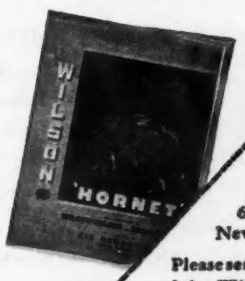

AA

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Please send me a free copy of the Wilson "Hornet" Catalog.

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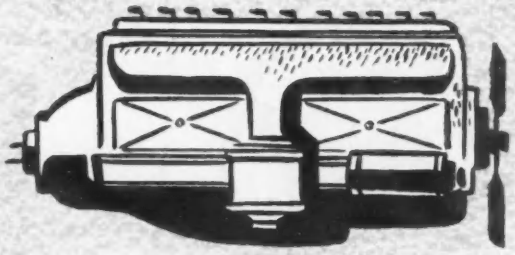
By protecting the fine orifices in Diesel engine injector nozzles from dirt in the fuel, Moraine Porous Metal filter elements safeguard engine performance and reduce maintenance in Diesel equipment of all types. Moraine Porous Metal is particularly qualified for this application by these characteristics: 1) Unique structure, attained by powder metallurgy, which provides tortuous flow passages for more efficient filtration. 2) Adaptability to fabrication in the most efficient shape. 3) Strength and ductility that permit press fits. 4) Adaptability to bonding so that the filter element and sealing gasket are an integral unit.

NO BIGGER THAN THE TIP OF YOUR FINGER

Yet This Unique Filter Element Is an Important Factor in Diesel Performance



MORAINE POROUS METAL

(Commonly known as* POREX*)

Moraine Porous Metal (Porex) is a unique product of powder metallurgy. It is made in four basic grades of fineness, with almost infinite graduations between them, and is available in varied shapes to meet design requirements.

If your product involves the flow of air, liquid or gases—as either an actuating medium, a combustion medium or a lubricating medium—you should find out what Moraine Porous Metal can do to improve your product's performance and extend its operating life. Moraine Porous Metal is performing varied functions for many industries—automotive, aviation, refrigeration, petroleum, pneumatic tool, industrial equipment, tractor, electric motor and others. Consult the Moraine Products Engineering Department for recommendations.

FILTRATION
DIFFUSION
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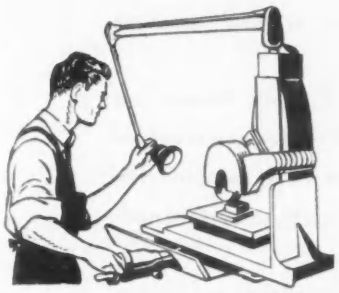
FLOW CONTROL
BREATHER VENTS
FLAME ARRESTERS

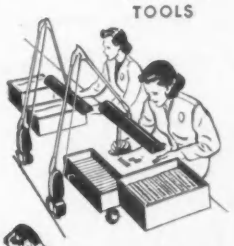
BUY WAR BONDS—SAVE LIVES

MORAINE PRODUCTS DIVISION OF GENERAL MOTORS
DAYTON, OHIO

You are looking at the first and only *Floating* LAMP

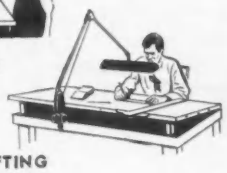


MACHINE TOOLS



ASSEMBLY LINES

INSPECTION BENCHES



DRAFTING BOARDS

FLOATING is the only word to describe the effortless action of the Dazor Lamp. For a slight touch will *float* this light exactly where it's needed, as easily as a man can move his arm. And it *stays put* without locking. Raise, lower, push, pull or turn the Dazor *Floating* Lamp — it remains firmly and automatically held in position. Thus *localized* lighting acquires new efficiency . . . increasing production, improving accuracy and safety, lowering costs.

Each job presents a separate problem of illuminating the working area. With the Dazor *Floating* Lamp an employee gets lighting *flexibility* at the point of work. He can control intensity . . . avoid reflected glare . . . curtail eye-strain, fatigue and error. A single spring force acting through an ingenious linkage and arm parallelogram balances the lamp arm in any desired position. Both Fluorescent and Incandescent Dazor Lamps are available; 4 bases cover every type of machine fastening and portable plant use.

In thousands of industrial and govermental operations, economical Dazor *Floating* Lamps are contributing to high productive capacity. They are distributed by electrical wholesalers, selected for ability to serve. Call your electrical wholesale supplier or write us for the names of our distributors in your locality. Upon request for Booklet "I" we will also send a 16-page Illustrated Catalog describing Dazor models, features, applications.

Dazor Manufacturing Co. • 4469 Duncan Ave., St. Louis 10, Mo.

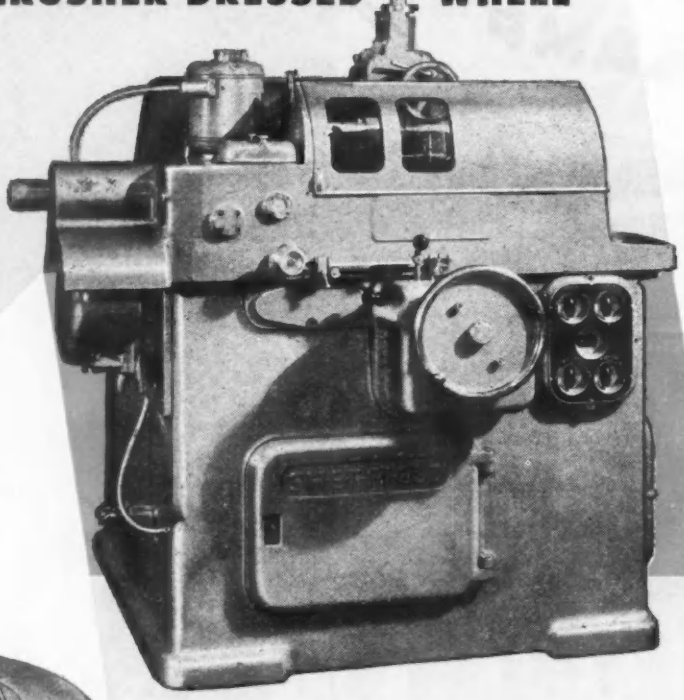
DAZOR *Floating* LAMPS

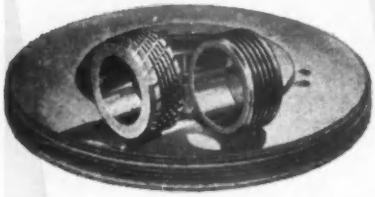
FLUORESCENT *and* INCANDESCENT

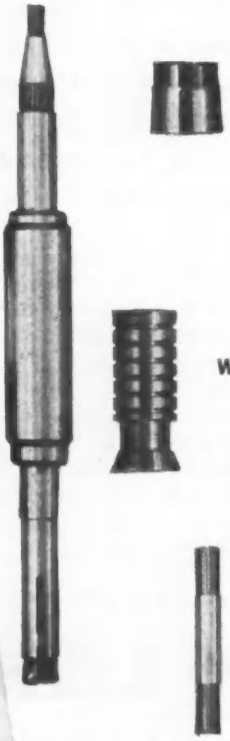
THREADS and FORMS

PLUNGE GROUND

WITH CRUSHER DRESSED WHEEL







The crusher dressed multi-ribbed grinding wheel offers important savings in both time and production costs in grinding precision threads and circular form or profile work.

In a plunge cut with such a wheel on the Sheffield Thread and Form Grinder, a single or multi-start threaded section, the length of which does not exceed the thickness of the wheel, is completed in 1-3/5 revolutions of the work part. For larger parts traverse grinding is used.

Wheels are crusher dressed in a small fraction of the time it takes by conventional methods and they have more effective cutting surfaces. Furthermore, the multi-ribbed wheel stands up longer.

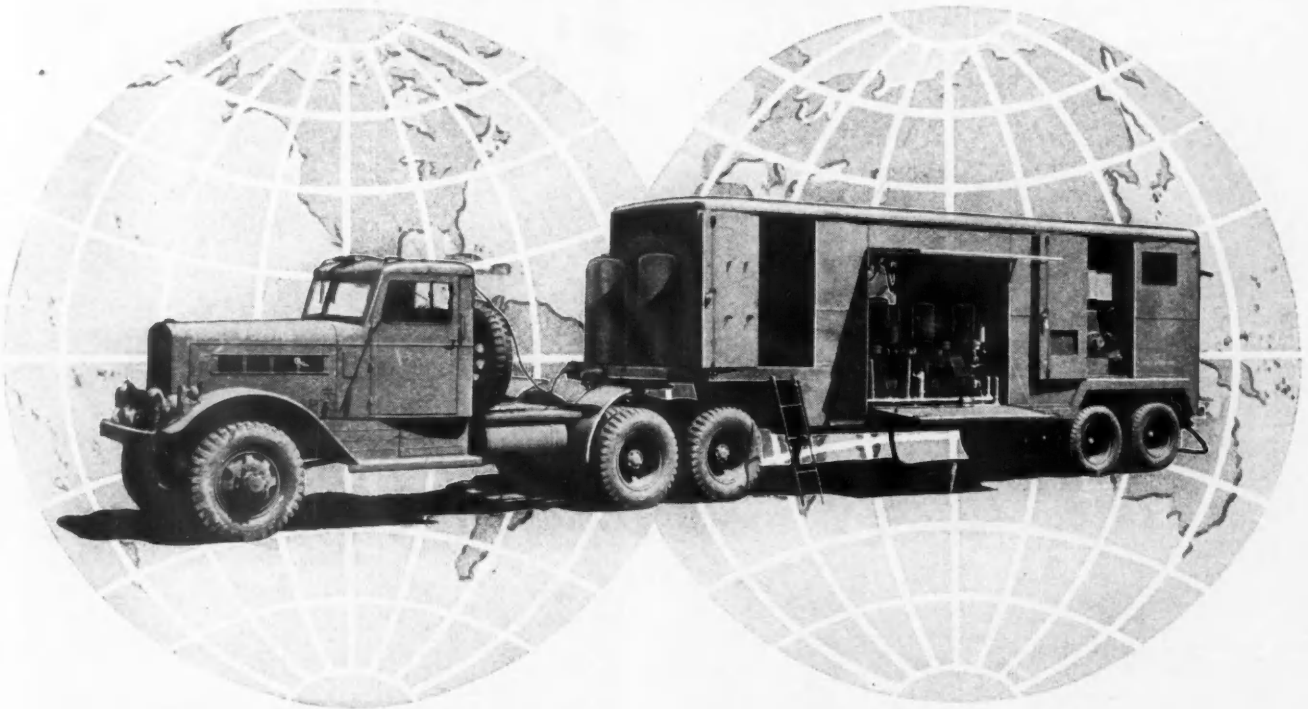
Write for technical bulletin.

THE SHEFFIELD CORPORATION

Dayton 1, Ohio, U.S.A.

MACHINE TOOLS • GAGES • MEASURING INSTRUMENTS • CONTRACT SERVICES

Where OXYGEN is Needed



. . . INDEPENDENT Mobile Oxygen Generators Produce It!

A World-Straddling Supply of Oxygen—*where* it is needed, *when* it is needed . . . produced on the spot by Independent Mobile Oxygen Generators, *Pioneer* Manufacturers of this type of equipment!

Oxygen—For the crews who man our planes—combat, reconnaissance or transport—a vital necessity. Before the plane reaches 10,000 feet, masks must be on and a steady stream of oxygen flowing into them. Flyers cannot function—perform their duties without it. Independent Generators produce oxygen at the flying strip or field.

Oxygen—On the battle-front—for maintenance and repair of mechanized and military equipment—jeeps, tanks, guns . . . oxygen for the cutting and welding torches which are the prime requisite of our fast-moving repair crews. Independent Mobile Generators produce oxygen close to the scene of action.

Oxygen—For the Medical Corps—for treatment in chest injuries, shock, respiratory illness or wherever breathing is affected. Independent Generators supply a steady stream of life-giving . . . life-saving oxygen for these casualties of war.

". . . The White Star, which the renewal adds to your Army-Navy Production Award Flag, is the symbol of appreciation from our Armed Forces for your continued and determined effort and patriotism."

Sincerely yours,

☆ ☆ ☆

In your Post-War Planning—remember that Independent will be able to serve you fully . . . in equipment for producing—transporting and handling of industrial gases.

INDEPENDENT *Engineering* COMPANY, INC.

Manufacturers of MOBILE OXYGEN AND HYDROGEN GENERATORS • BUILDERS OF OXYGEN, HYDROGEN AND ACETYLENE PLANTS • MANUFACTURERS OF INDUSTRIAL GAS CYLINDERS AND CYLINDER HANDLING EQUIPMENT

INVEST IN VICTORY — O'FALLON, ILLINOIS — *Buy* MORE WAR BONDS

. . . and ~~never~~ the twain shall meet

"East is east and west is west," wrote the poet, "and never the twain shall meet."

But he was wrong.

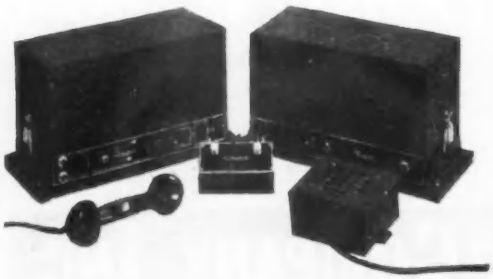
The twain *shall* meet. The peoples of the earth shall begin to know each other — and work together — for peace and plenty for all.

And the miracle will be due in great part to the coming Age of Flight. . . .

Communications will help make Air Transport safer — more economical — faster. Harvey-Wells Electronics produces communications equipment designed for complete dependability, engineered for maximum efficiency . . . selected for War, perfected for Peace.

In the Age of Flight, look to Harvey-Wells for ideas, skill, imagination — setting the pace for progress in communications!

Know the company that wants your business! Our CASE BOOK tells the story of Harvey-Wells and its place in Electronics. Send for it today. Your name on your letterhead is sufficient.

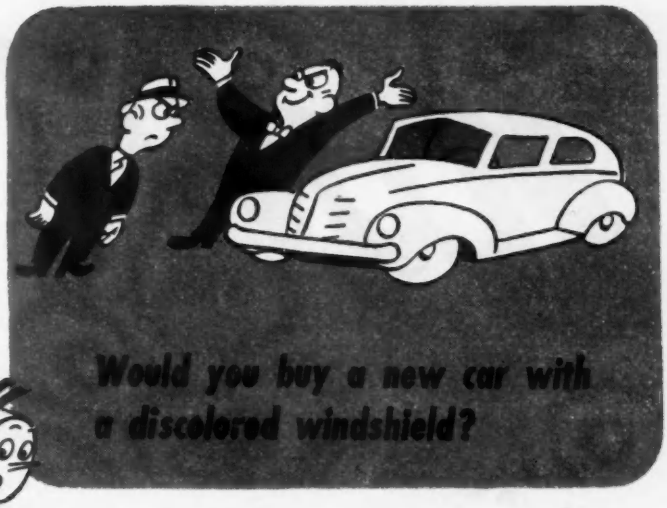


Harvey-WELLS
ELECTRONICS

SETTING THE PACE FOR PROGRESS IN COMMUNICATIONS

HARVEY-WELLS ELECTRONICS, INC. SOUTHBRIDGE, MASSACHUSETTS

"Filmonize" Transparent Tape is Transparent



Clear as spring water—you can see right through to the core—that's "FILMONIZE" Transparent TAPE!

We welcome comparisons. Take a yard or a roll of "FILMONIZE" Transparent TAPE, place it beside the TAPE you now use and you'll see the difference. "FILMONIZE" SELF-SEALING TAPE speaks for itself.

Call your local distributor for a demonstration today. He can deliver "FILMONIZE" SELF-SEALING TAPE in quantity for all industrial or commercial uses.

FILMONIZE SETS NEW STANDARDS

- Easy to use . . . strips easily from roll.
- No "curl-back" . . no tangle . . no waste.
- Seals without water.
- Widths from ½" to 18" throughout the "FILMONIZE" line.

Filmonize
TRADE MARK REG
SELF-SEALING TAPES

INTERNATIONAL PLASTIC CORPORATION
MORRISTOWN, NEW JERSEY

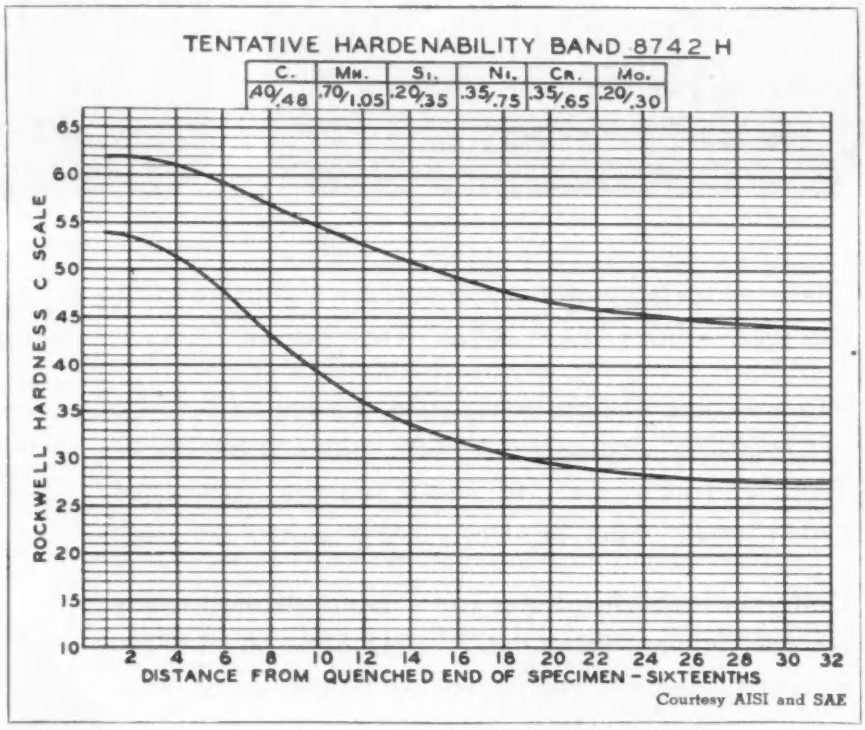
Now... You can buy Alloy Steel to BAND HARDENABILITY

To avoid quenching cracks and at the same time insure a thoroughly effective quench and maintain specified physicals, more and more engineers are finding it desirable to order alloy steel to maximum and minimum hardenability ranges.

These maximum-minimum ranges, based on standard end-quench hardenability tests, have been charted for some 4100, 4300, 4600, 8600, and 8700 types of steel, and acceptable figures are now available in booklet form.* Each chart is based on a study of many heats representative of the entire steel industry.

The practical value of band hardenability is best illustrated by a specific example, as follows:

Suppose your experience has indicated that a 1½-inch round, oil-quenched, must show center hardness between Rockwell C 45 and C 58 to successfully pass manufacturing operations. A check of standard hardenability curves at approximately the 7/16-inch point will show that Analysis 8742H (H for hardenability) is one steel that will do the job.



Courtesy AISI and SAE

BETHLEHEM metallurgists have had an active part in the standardization of maximum-minimum hardenability values established for the industry. Our technicians will be glad to work with you and your staff on practical applications of these findings.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Bethlehem Steel Export Corporation
New York City

★ ★ ★ ★ ★ ★ ★ ★ ★

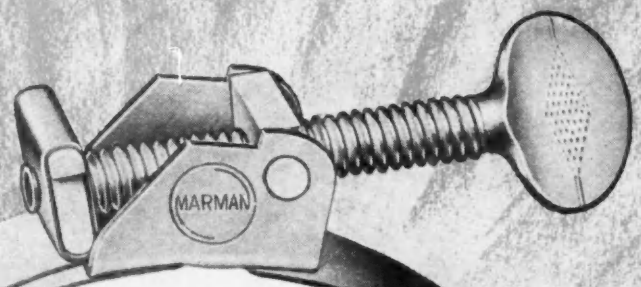
BETHLEHEM STEEL ★

*"Contributions to the Metallurgy of Steel, No. 11," published by the American Iron and Steel Institute and the Society of Automotive Engineers.

Approved

BY BOTH

ARMY & NAVY



THE MARMAN UNIVERSAL HOSE CLAMP—SERIES 820

Now, for the first time, one clamp combines *all* these features: ✓ stainless steel construction ✓ re-usability ✓ self-locking screw with high back-off torque ✓ corrosion resistance ✓ adjustability —3 sizes handle hose diameters from $^{11}/_{16}$ to 3-$^{9}/_{16}$ O. D. ✓ non-slipping band conforms to hose contour and clamps irregular shapes with equal efficiency.

Marman also makes standard fixed contour hose clamps in stainless steel and aluminum alloy, as well as the Marman Quick-Coupler in stainless steel or aluminum alloy. Write today for *new* folder, Series 820.

MARMAN
PRODUCTS CO. Inc.
940 WEST REDONDO BOULEVARD
INGLEWOOD, CALIFORNIA

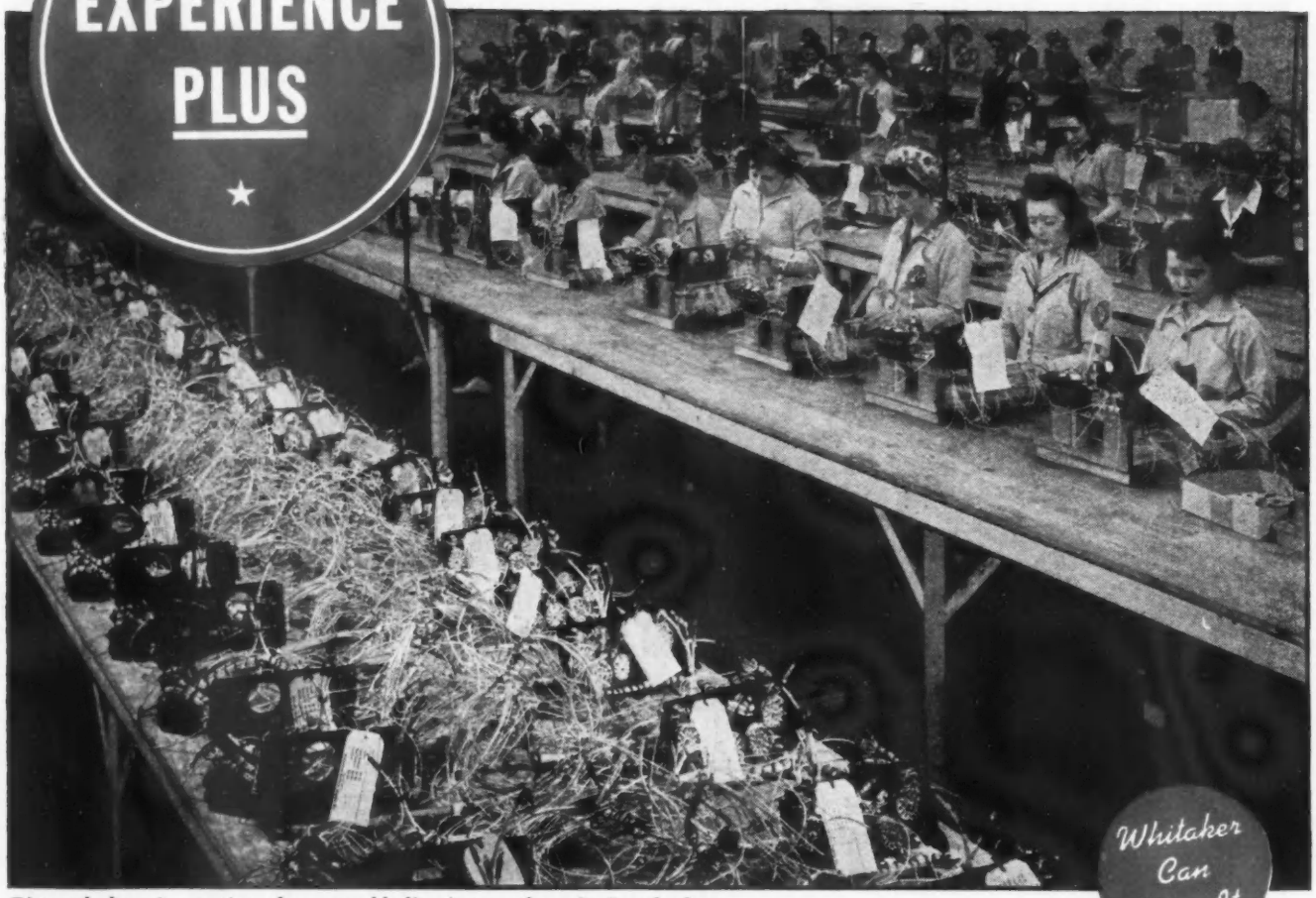
EASIER TO INSTALL!

1. Retract screw fully. Wrap band around hose and insert end through opening in saddle.

2. Pull up snug, fold band down inside saddle, tighten screw.

Marman's exclusive swivel-action nut rocks on swivel pins and when screw is tightened, tips down, cinches band and prevents slipping.

EXPERIENCE PLUS



Pictured above is a section of an assembly line in one of our St. Joseph plants.

SAVE TIME and GRIEF

by having Whitaker produce your wiring assemblies

A quarter of a century of experience is made available to you when you turn your wiring harness and assembly jobs over to Whitaker.

You will find that the statement "Whitaker can wire it" is no idle boast . . . We have the experience, *plus* ample plant facilities for volume production . . . All Whitaker produced assemblies are engineered to specifications, and pass exacting inspections.

In addition to custom-built engineered wiring assemblies, Whitaker also offers a quality line of standard stock cable products . . . We cordially invite you to write and advise us of your needs.

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General Offices: 1305 Burlington Avenue, Kansas City 16, Missouri
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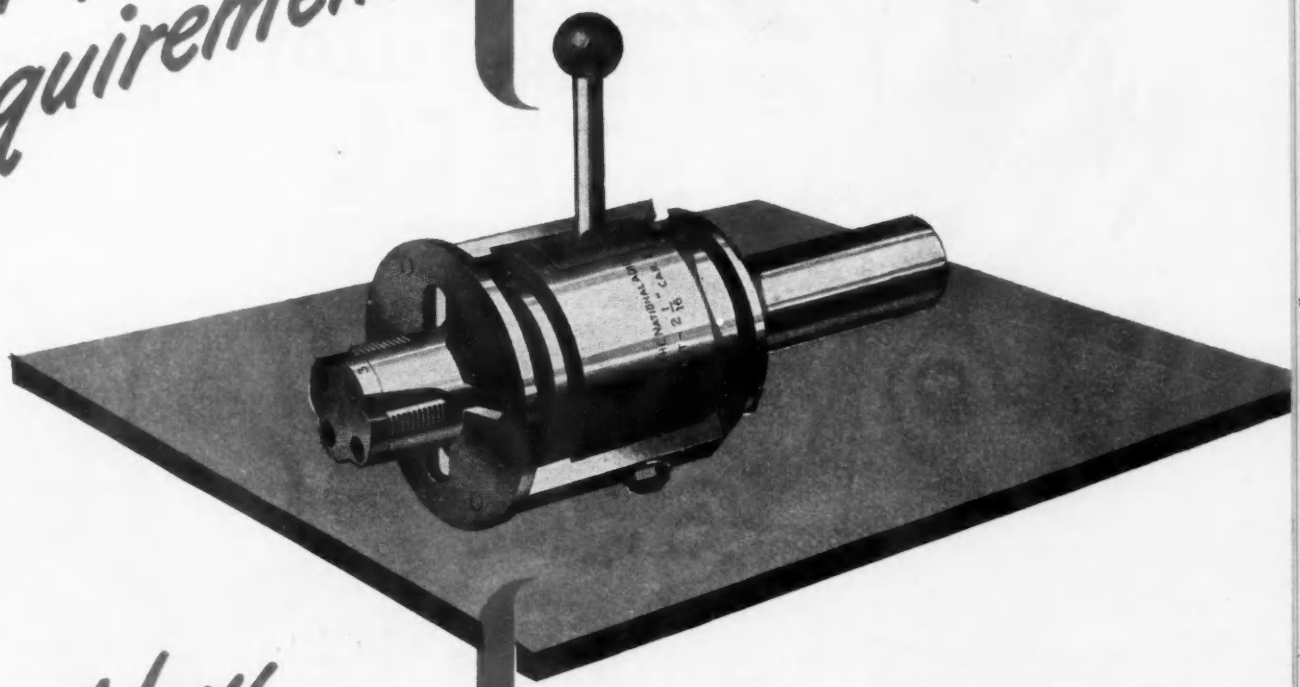
Cables, Wiring Harnesses and Assemblies for Automotive, Aircraft, Marine and Radio Equipment

New Tapping Requirements

Tougher alloys
Finer Limits
Smoother finish
Longer runs



New Namco Tap meets them ALL

This new "RST" Collapsible Tap retains the design advantages of back supporting chasers their full length on heavy core piece, side supporting by heavy body—stamina for tough alloys.

Ground thread chasers—for fit and finish.

New Feature is *positive* and *instant* control at point set for collapsing, no lost motion, and chasers reset to precise diametric adjustment.

RST is a universal, double-duty tool—simply remove handle for revolving spindle machines —a BIG saving in tool investment.

Send for your copy of New Tap and Die Catalog D-42-B. Complete information on automatic taps and dies made especially to serve the higher standards of precision at lower threading costs.

THE NATIONAL ACME CO.

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ACME-GRIDLEY 4-6 AND 8 SPINDLE BAR AND CHUCKING AUTOMATICS • SINGLE SPINDLE AUTOMATICS • AUTOMATIC THREADING DIES AND TAPS
THE CHRONOLOG • LIMIT, MOTOR STARTER AND CONTROL STATION SWITCHES • SOLENOIDS • CENTRIFUGES • CONTRACT MANUFACTURING

Dependable as the name it bears.

DISSTON
STANDARD ALLOY STEEL

(*Including National Emergency Steel Compositions*)

- made by modern tool steel practice
- in electric furnaces
- of carefully selected materials
- under precise control and expert supervision
- resulting in an exceptionally sound and clean product, which
- measures up to the Disston standards of quality

Aircraft Quality for AIRPLANE PARTS

Gun Quality for GUN BARRELS, RIFLE and TORPEDO PARTS

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YOUR POSTWAR PLANS Do they include the use of Fine Tool Steels? Profit from the wide experience of Disston metallurgists and engineers in the production of quality tool, alloy, and carbon steels. They will gladly advise you and cooperate with you—in confidence and without obligation. When writing, please give full details.

HENRY DISSTON & SONS, INC., 1231 Tacony, Philadelphia 35, Pa., U. S. A.

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BAKELITE

TRADE-MARK

Ideas are Ammunition, Too

This is the largest item ever molded from BAKELITE phenolic molding board, BM-9725. It's an ammunition box for a bomber belly turret that packs looped lightning in the form of long belts of cartridges. It is 25½ in. by 17½ in. by 6½ in. in size. It is extremely lightweight, highly resistant to impact, abrasion, moisture, and chemicals, and has high tensile strength.

Until now, the plastics industry has used BAKELITE phenolic molding board chiefly for much smaller parts. The idea of employing its outstanding advantages for a large scale molding job was revolutionary, but has more than justified itself in a product that stands strenuous service, and is economically produced. Rigidity and extra strength are attained by molding the box from two sheets of BM-9725 around a sisal core that has been impregnated with phenolic resin. Both halves of the box are formed simultaneously in one cast iron mold. The press is equipped with banks of infrared lamps for preheating the mold charge and operates at a pressure of 1,000 pounds per square inch.

Ideas such as those that produced this box are ammunition for present and future planning—ammunition that hits the mark in product improvement and production economy. BAKELITE molding boards are available in sheets, blanks, and as diced material. They can be molded on existing equipment—either alone, or in combination with other BAKELITE plastics to reinforce vital points. Write Department 27 for full information and suggestions regarding molding techniques.

TRADE MARK

BAKELITE CORPORATION, 30 E. 42 St., New York 17, N. Y.

Unit of Union Carbide and Carbon Corporation

UCC

Molding Plastics

MERCHANDISE IS ON THE MARCH

Hats off to that valiant army of commercial truckers whose efforts to supply the home front have eased the sting of wartime shortages ★ But for the never-say die philosophy of this organization and the recognized stamina of the finest rolling stock in the world, this country would have been faced with a condition which, by comparison, would have dwarfed our current inconveniences ★ We, of Bendix-Westinghouse, are not without pride for the heavy role Air Brakes and Pneumatic Controls have played in this Victory on the home front. More especially, we are grateful for those countless, unsolicited statements from operators who credit Bendix-Westinghouse Equipment for a major share of their accomplishment in keeping units rolling, safely, efficiently and economically ★ Naturally, in view of the record, you will be interested in the many exclusive advantages this world standard of safety holds for you. To relay this information, a nationwide chain of Bendix-Westinghouse Distributors is waiting and ready to survey your individual control requirements.

BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY . . . ELYRIA, OHIO

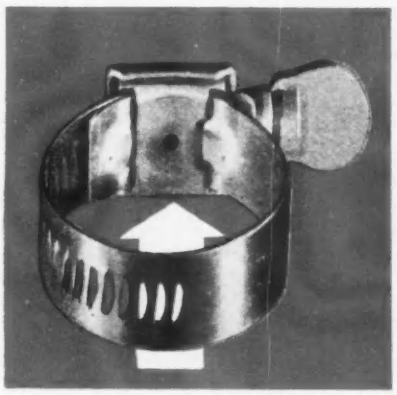
Bendix-Westinghouse

AIR BRAKES

AND PNEUMATIC CONTROL DEVICES

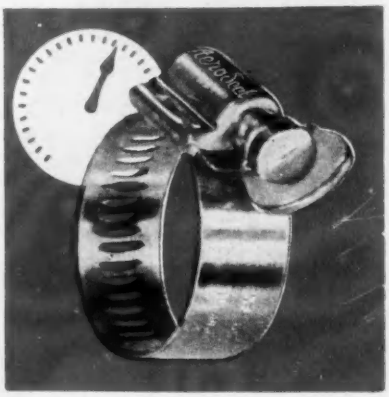
IT IS SIGNIFICANT THAT AMERICA'S FINEST MOTOR TRUCK FLEETS ARE EQUIPPED WITH BENDIX WESTINGHOUSE AIR BRAKES

FIVE
ENGINEERING FEATURES



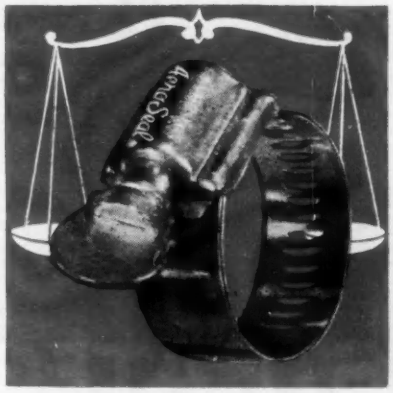
NON-WELDED SADDLE

CORROSION RESISTANT



GREATER BAND STRENGTH

GREATER FLEXIBILITY



LIGHTER WEIGHT

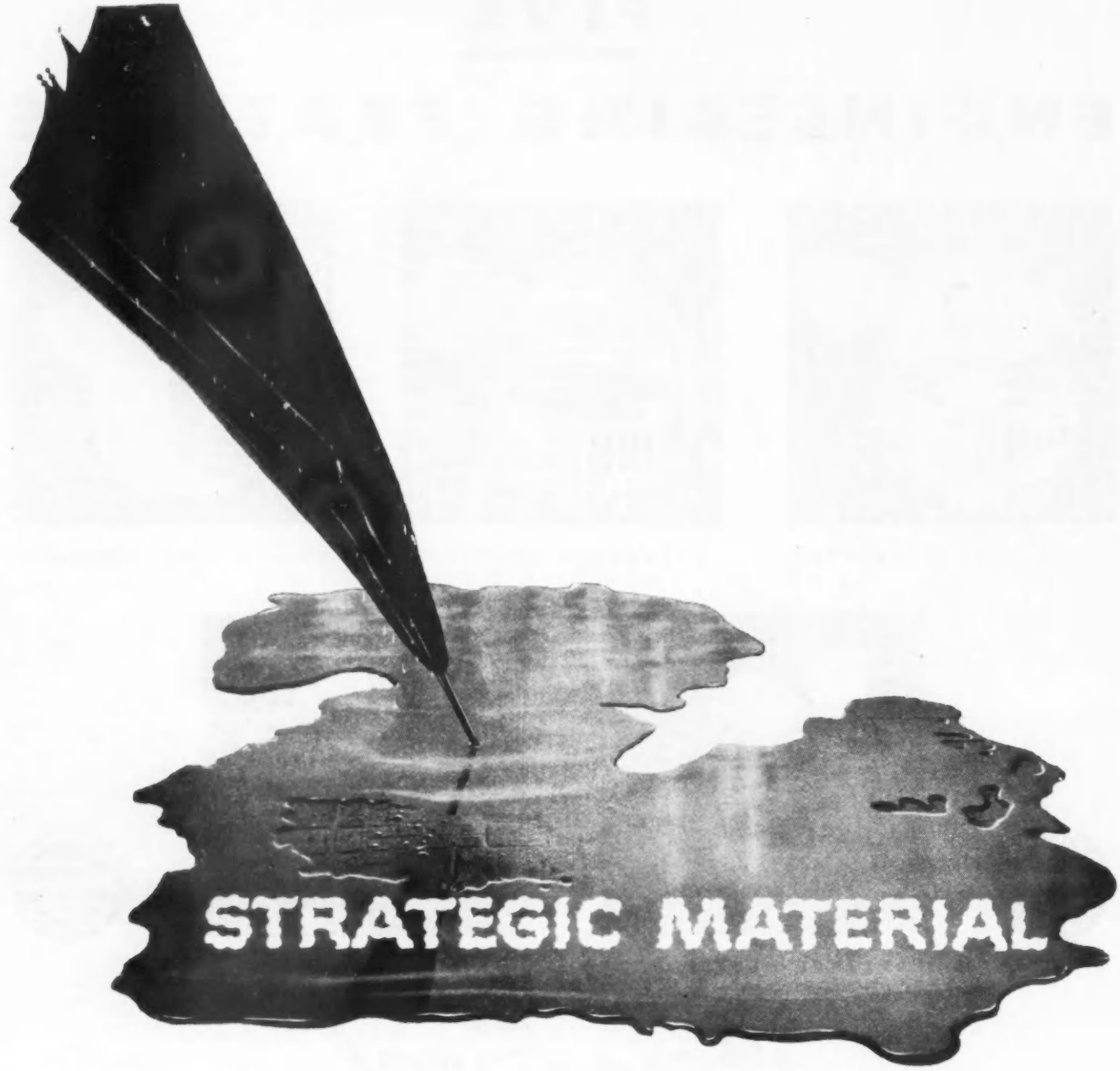
AIRCRAFT Standard PARTS CO.

AIRCRAFT Standard PARTS CO.

"Aero-Seal"
STAINLESS STEEL WORM DRIVE
HOSE CLAMPS

FIVE outstanding constructional features of "Aero-Seal" STAINLESS STEEL Hose Clamps are indicated above. The new mechanically interlocked saddle removes any doubts as to uniformity of welds at this vital point. Corrosion resistance is inherent with ALL-STAINLESS-STEEL parts. Stainless has greater tensile strength than carbon steel, producing greater band strength even though the band is thinner. The lighter, stronger stainless steel band has greater flexibility and the whole clamp is lighter in weight throughout with a gain, rather than loss, in durability and holding power. *In addition,* you get all the basic "Aero-Seal" features — smooth and powerful worm gear drive, compact housing, no loose parts, openable band, vibration-proof holding, wide range, long take-up, uniform pressure, no distortion of thin-wall tubing, and ability to hold high pressures without leakage. Remember — *we originated* the "Aero-Seal" design and offer you the further advantage of longest experience in the manufacture of this new and better type of hose clamp.

AIRCRAFT STANDARD PARTS CO.
1717 NINETEENTH AVE., ROCKFORD, ILLINOIS



Water . . . enormous quantities of it . . . are used in industrial cooling operations. Water comes into the plant *cool*—goes down the drain *hot*.

But war has caused acute water shortages in many industrial localities. Plant engineers then face a real problem . . . especially where continuous processes require continuous cooling, and lack of water can stop production or cause serious damage.

Solving this problem in many a war plant, G-E *evaporative* cooling equipment makes as little as five gallons do the work of 100 gallons! With evaporative cooling, water is cooled and used again and again. Comparatively little fresh water is needed.

If water has become a strategic material in your plant, learn how G-E evaporative cooling can help conserve it. And remember, the same equipment that saves *water* also saves money—by reducing water costs. In fact, in most installations, water savings *alone* are sufficient to pay for the cost of the equipment!

For information write: *General Electric Company, Air Conditioning and Commercial Refrigeration Divisions, Section 445, Bloomfield, N. J.*

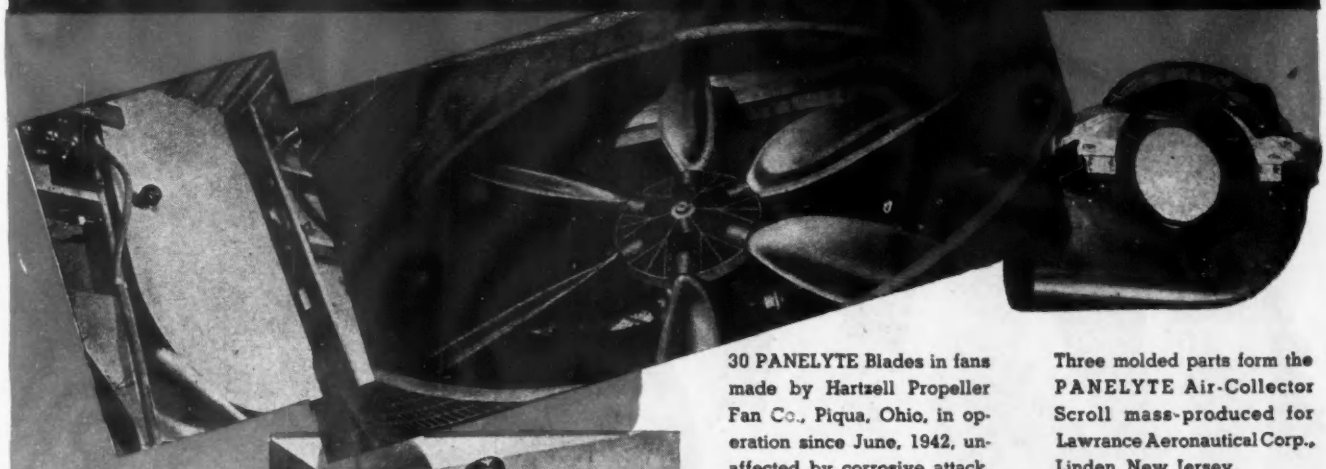
☆ BUY WAR BONDS ☆

Industrial Cooling by

GENERAL ELECTRIC

Hear the General Electric Radio Programs: The "G-E ALL-GIRL ORCHESTRA," Sundays, 10 p. m., E W T, N B C . . . "THE WORLD TODAY" News, Every Weekday, 6:45 p.m., E W T, C B S

PANELYTE* Precision Molding



30 PANELYTE Blades in fans made by Hartzell Propeller Fan Co., Piqua, Ohio, in operation since June, 1942, unaffected by corrosive attack.

Three molded parts form the PANELYTE Air-Collector Scroll mass-produced for Lawrance Aeronautical Corp., Linden, New Jersey.

Fuselage Door, designed by PANELYTE engineers in cooperation with Glenn L. Martin Co., saves weight and has superior resistance to vibration. Both sections of complex part molded in one press in a single operation.

Navigator's Table Drawer molded of paper base PANELYTE; pull handle is integral part; unit shipped ready to install.

PANELYTE Aircraft Flooring —laminated top sheet molded onto a corrugated base with aluminum insert integrally molded into lower horizontal surface—surpasses all standard floorings in high strength, lightweight characteristics. Developed by Martin engineers and used in Martin "MARS".

Permits Unusual Sizes and Intricacy of Design

So rapidly have PANELYTE molding techniques advanced that parts molded in straight-line mass production today would have been considered impractical, if not impossible, 2 or 3 years ago. Weight-saving parts illustrated show wide variation and intricacy of design now attained by compression molding in powerful hydraulic presses. Steel or special alloy dies are used for curing and setting PANELYTE parts – including some of the largest yet to be produced in thermo-setting plastic. Sharp compound curvatures and considerable depth of draw also easily handled.

You will find our Engineering Staff of practical assistance in the design and economical production of fabricated as well as molded parts in paper, fabric, fibre glass and asbestos base laminated plastics.

PANELYTE *the structural plastic*

PANELYTE DIVISION
ST. REGIS PAPER COMPANY
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NEW YORK 17, N. Y.

Sales Offices: Atlanta, Boston, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Kansas City, Los Angeles, Mexico City, Montreal, New Orleans, St. Louis, St. Paul, San Francisco, Seattle, Syracuse, Toronto, Trenton, Vancouver

*MASS PRODUCTION OF SHEETS, RODS, TUBES, MOLDED FORMS, FABRICATED PARTS

Credit where credit is due

IF industry's effort in this war has proved anything, it has demonstrated the ingenuity of America's designers, engineers and production men in "making things do."

Never before have materials had such an opportunity to strut their stuff. Under the hard necessities of war, they have revealed a versatility and hidden virtues undreamed of even by their producers.

Plastics, plywood, aluminum, glass and steel have taken on jobs far afield from their accustomed well-grooved functions. They have swapped places one with the other in countless unusual applications. Today they present industry with a whole new world of design possibilities for the future.

But in the picture of wartime accomplishment, one thing stands out. It is the fundamental, basic importance of steel and the wide diversity of its use. Steel has been the very backbone of our war effort. As shortages developed, steel has pinch-hit for one material after another.

As producers of steel, our hat is off to the wonderful job competitive materials have done in this emergency. But as the time approaches when your choice of materials for peacetime products will once again be governed by the true economics of their application, our hat is definitely in the ring.

Steels that meet the challenge of today and tomorrow

U·S·S CARILLOY ALLOY STEELS—S.A.E. and Aircraft Quality Steels for the special jobs of industry.
U·S·S HIGH STRENGTH STEELS to carry high unit stresses and to reduce weight to a minimum at low cost.
U·S·S ABRASION-RESISTING STEELS to combat wear and friction.
U·S·S COPPER STEELS to give twice the atmospheric corrosion resistance of regular steel at little additional cost.
U·S·S HOT-ROLLED AND COLD-ROLLED STEELS to provide the basic advantages of steel, plus maximum economy.
U·S·S STAINLESS AND HEAT-RESISTING STEELS to endure temperatures disastrous to other metals—to resist highly corrosive environments.

ONLY STEEL CAN DO SO MANY JOBS SO WELL

USS

CARNEGIE-ILLINOIS STEEL CORPORATION
Pittsburgh and Chicago
Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

UNITED STATES STEEL

New Hydraulic Control for Trucks and Busses

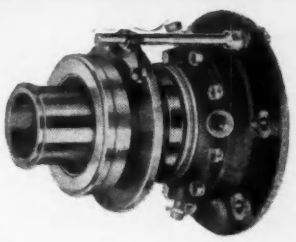
In heavy-duty operation such as illustrated, the Hydrolease will offer particularly important advantages.

Here's a remarkable new hydraulic development revolutionizing operation of clutch throw-out mechanisms in heavy-duty motor vehicles.

The PESCO *Hydrolease*, a hydraulic clutch actuator, brings the smooth, positive force of hydraulics to clutch control. It materially reduces clutch pedal load, easing operation and strain on both driver and vehicle. It makes clutch pedal action more accurate, reduces wear and maintenance on the clutch, and eliminates many mechanical parts.

The PESCO *Hydrolease* has been thoroughly tested in the laboratory and *on the road*. It's ready for specification now. Write for full details. PESCO Products Co., Automotive Division A, 11610 Euclid Ave., Cleveland 6, Ohio.

PESCO HYDROLEASE



IMPORTANT ADVANTAGES

1. New ease and smoothness in clutch operation. Clutch response is more accurate. Eliminates "creeper gear jerk".

2. Lightened clutch pedal load, approximately 50 per cent less.

3. Constantly adjusted clutch clearance between the clutch release bearing and the clutch throw-out mechanism. Saves clutch plate linings.

4. Reduced weight, reduced number of working parts, reduced maintenance cost.

5. On one typical bus installation the PESCO *Hydrolease* eliminates 42 working parts, 19 points of lubrication . . . and its cost, 60 per cent less.

In Precision Hydraulics, Fuel Pumps, Air Pumps, Related Accessories . . .
PERFORMANCE POINTS TO Pesco FIRST

Checking strut in Drop Test Rig

Testing brake power on 30-ton dynamometer

YOU take no chances because WE take none with BENDIX LANDING GEAR

From blueprint to bomber, fighter, or transport plane, Bendix landing gear is under the constant supervision of men with the broadest experience in this highly specialized field.

One outstanding advantage provided by this experienced personnel is the forethought shown at every stage. Strains, shocks and performance requirements are accurately foreseen—and the ability of the landing gear to meet them is predetermined in a series of practical tests in the best-equipped laboratories available anywhere.

Trustworthy—that sums up the dominant characteristics of this fine product of Bendix Creative Engineering. For proof, simply check the list of manufacturers who rely on Bendix landing gear for safer, easier take-offs and landings.

BENDIX LANDING GEAR—Bendix Pneudraulic Shock Struts, Bendix Airplane Wheels, Airplane Brakes, Hydraulic Master Cylinders, and Power Brake Valves make up the list of Bendix Landing Gear equipment.

Bendix PRODUCTS DIVISION

BENDIX AVIATION CORPORATION, SOUTH BEND 20, INDIANA

PILOTS LIKE NOTHING UNDER THEM . . .

Safety officials look kindly on *Foamex* seat cushioning because it treats pilots so kindly.

It helps keep efficiency up, safety ratings high, by cutting down fatigue.

It combats the deadly tiresomeness of sitting in one spot, in one position, for long stretches.

It cradles pilots on super-buoyancy that guards against cramped muscles, blocked circulation.

It floats them on millions of air-breathing latex cells that valve out vibration and shock.

Nothing's so soft as air. Those *Foamex* air cells make seats soft right down to the frame.

Nothing's so resilient as latex, with its natural springiness multiplied by Firestone's foaming process. *Foamex* makes seats springy through and through, instead of just on the inside.

The combination is unmatched for cushioning power. That's why *Foamex* is strictly military until Victory. Every ounce is needed to shield fighting men and instruments from concussion.

Meanwhile remember—*Foamex* is just as kind to maintenance folks as it is to pilots.

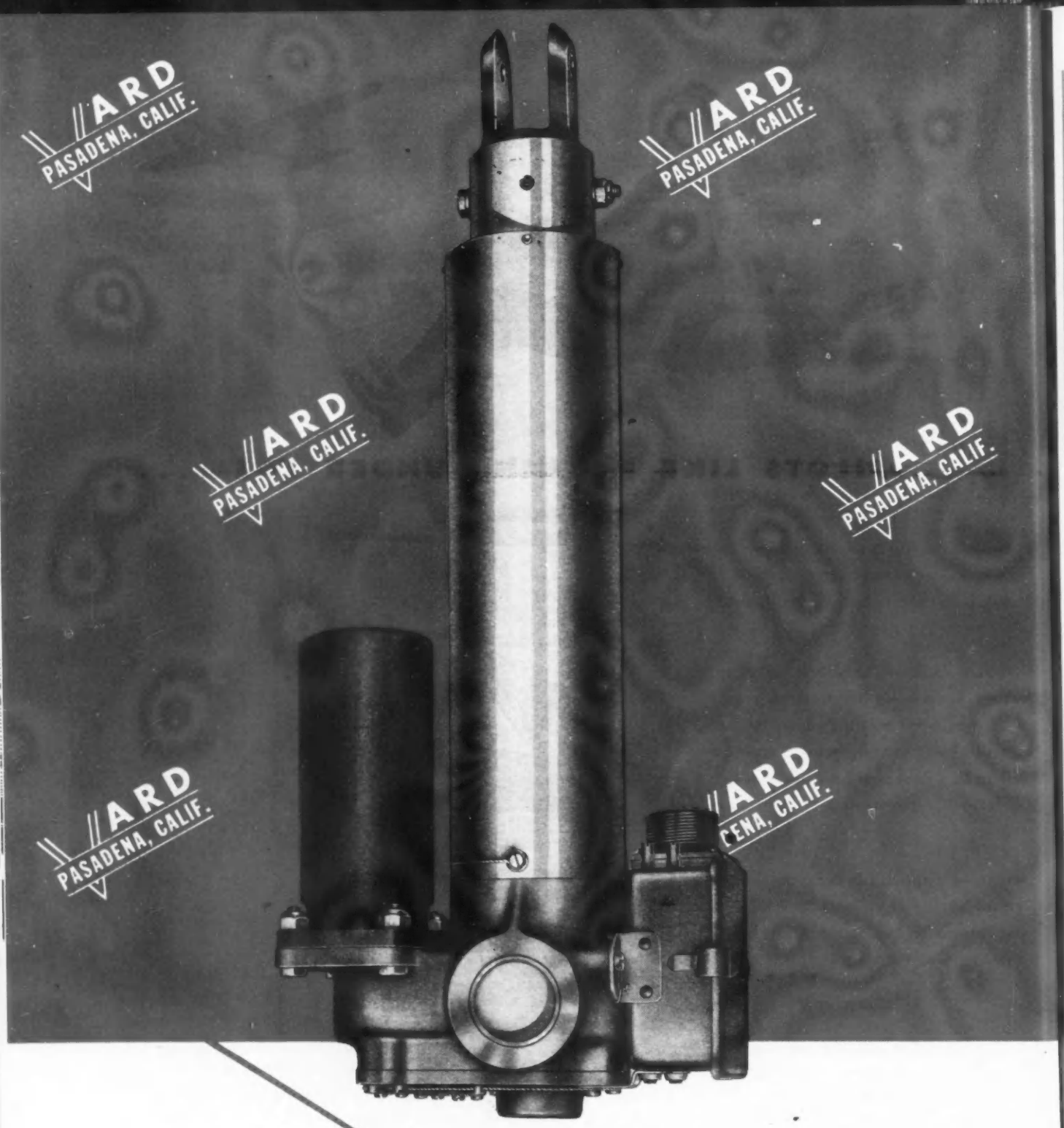
A *Foamex* seat is one molded piece, with no loose innards, good for thousands more miles of sag-free wear!

P.S. The ideal covering for *Foamex* seats—*VELON**, Firestone's wonder fabric. Makes smarter colors practical.

*TRADEMARK

ANOTHER CONTRIBUTION TO A BETTER WAY OF LIFE by **Firestone**

LISTEN TO THE VOICE OF FIRESTONE MONDAY EVENINGS OVER NBC



We are glad to announce that VARD INC. is now manufacturing electrically powered, mechanical actuators for aircraft.

This addition completes our line, as we have built hydraulic cylinders, valves, switches and fluid actuators for several years.

We are able with the facilities of our own foundries, machine shops, thread grinding, gear generating, honing and plating departments to produce these mechanical actuators almost in toto. Steel tubing, screws, wire, bearings and motors are the parts we do not make.

VARD facilities are always available to help design and build your special aircraft requirements.

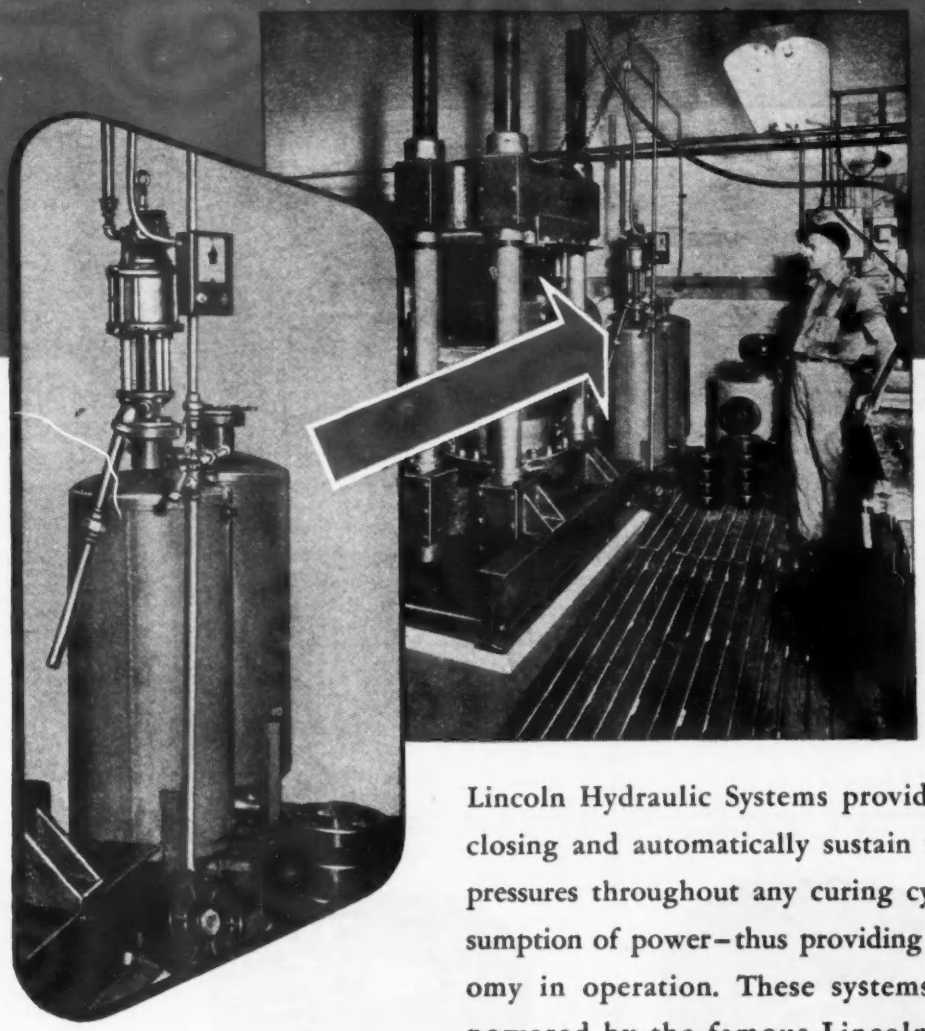
MECHANICAL ACTUATORS

Now Manufactured by...

VARD INC.

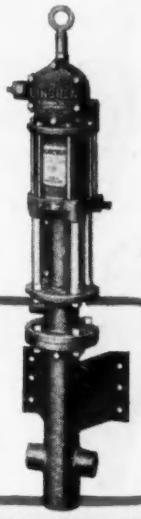
PASADENA 8, CALIF.

LINCOLN HYDRAULIC SYSTEMS *for* HYDRAULIC PRESSES



Illustrated at left is a Lincoln Hydraulic System operating an H. P. M. 18" Diameter Ram press—molding Phenolic Resin industrial truck wheels.

Lincoln Hydraulic Systems provide rapid daylight closing and automatically sustain selected molding pressures throughout any curing cycle without consumption of power—thus providing exceptional economy in operation. These systems are powered by the famous Lincoln Air Motor which has long proven its reliability and efficiency in many industrial applications and under the most adverse operating conditions.



H44-1

Hydraulic System Selection

Recommendations of the proper Lincoln System will be made by our Engineers upon receipt of the following information . . . Ram diameter—Maximum stroke—Platen size—Total weight of Platen, ram and dies—Distance and speed of daylight closing—Maximum compression stroke—P. S. I. ram pressure—Time of cycle desired—and any other related facts affecting operation.

•

BUY EXTRA WAR BONDS—NOW

LINCOLN BOOSTER PUMPS
for Hydraulic Systems

•

Selected high pressure automatically sustained without horsepower consumption—no by-passing or pressure relief valves.

ARMY E NAVY

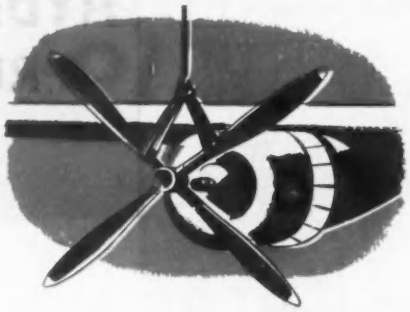
LINCOLN ENGINEERING COMPANY

Pioneer Builders of Engineered Lubricating Equipment

5701 NATURAL BRIDGE AVE., ST. LOUIS 20, MO., U. S. A.

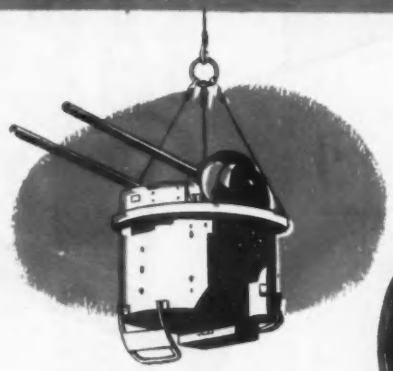
LINCOLN

LIGHTEN LIFTING PROBLEMS
with P&N Sling Fittings, Hooks and Rings



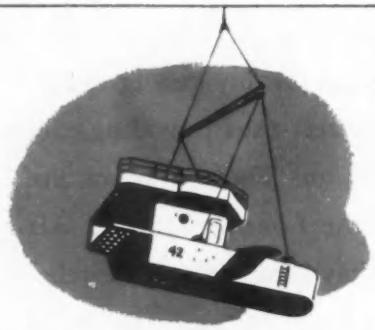
DIRECT LINE SWAGED HOOKS

P&N Direct Line Swaged Hooks are made of stainless steel and so designed that the load is on a direct line from the cable. Tests have shown their holding factor is in excess of cable. Available for 1/16 to 1 inch cable.



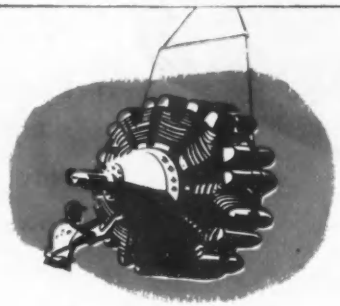
P & N CLEVIS RINGS

Made of alloy steel, these P & N Clevis Rings are carefully formed to retain the full strength qualities of the steel. They are cadmium plated and will fit any standard cable terminal. Available in sizes for 1/16 to 1 inch cable.



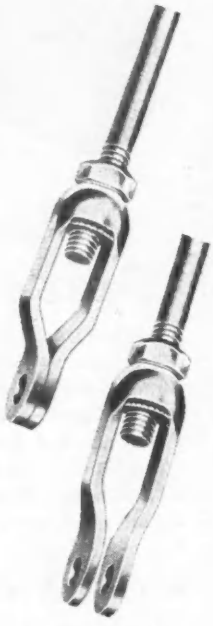
SOCKETYPE CABLE TERMINALS

Stamped and drawn from 41/30 alloy steel with a strength factor greatly in excess of cable, their use saves cable—allows cable to swivel freely when loose, thus eliminating kinking—and also provides a smooth foul-free installation. Available in both fork and eye types to fit cables of 1/16 to 1 inch diameter.



P & N COMMERCIAL ROD ENDS

Designed for use with spreader bars, P & N Rod Ends are equally adaptable to push-pull rods such as aircraft throttle controls and automotive tie and brake rods. Their use allows an unusually wide range of adjustment and is positive when adjustment is set. Available in both fork and eye types for 1/8 to 1 inch rods.



PN

POULSEN & NARDON, INC.

TERMINAL BOX 2398 — LOS ANGELES 54, CALIFORNIA

Established 1922

New Folder Available to Industry Personnel

NOW, perhaps more than any time in the history of mankind, do we realize the importance of the spiritual ties that bind us to our fellow men. Now must the light of our Faith shine forth as never before . . strong . . fervent . . staunch and true ☆ Let our Faith bring Light and Hope where there is sickness and despair. Let it bind and heal the wounds of a world tortured and sickened by war and pain ☆ Let our Faith give us the courage and fortitude to work on and fight on to preserve for ourselves and the less fortunate peoples of the world the Four Freedoms to which this nation has dedicated her might ☆ For in the strength of our Faith and Determination lie the Hope of the World for Peace on Earth, Good Will to Men.

Good Friends . . . to you we extend bright hopes and most cordial Season's Greetings

McAleer MANUFACTURING CO.

QUALITY-CONTROLLED
Automotive - Household - Industrial
FINISHING MATERIALS

ROCHESTER, MICHIGAN

McALEER MANUFACTURING CO., LTD. • WALKERVILLE, ONT.

Can You SEE the DIFFERENCE in these Gears?

Of course you can't see the difference—but it's there. One gear has been *shot-peened* and the other hasn't.

The shot-peening operation is just one of the added values that mark the Fuller Transmissions which will be available for your peace-time operations. The full explanation is too long and technical to be repeated here, but it is a method of treating gears (or any metal parts subject to stress) by "pre-loading" the surface to prolong life and delay what is commonly called fatigue failure.

Fuller was the first manufacturer of heavy duty truck transmissions to adopt this relatively new process. Gears so treated have been running in Fuller Transmissions for a considerable time, and the results have been uniformly successful.

The Fuller Transmissions of Tomorrow will be better than ever. And that—in view of Fuller performance during the trying war years—is saying a lot.

Fuller TRANSMISSIONS

FULLER MANUFACTURING COMPANY, KALAMAZOO, MICHIGAN
Transmission Division
Unit Drop Forge Division, Milwaukee, Wisconsin

CONSTANT FLOW OF POWER THROUGH

ROLLING ACTION—

GEARGRIND

RZEPPA CONSTANT VELOCITY UNIVERSAL JOINTS

Catalog on Request

THE transmission of power from one rotating shaft to another through the Rzeppa Constant Velocity Universal Joint makes possible many applications that were impractical with old style universal joints.

Rzeppa Universal Joints have proved their mechanical efficiency, freedom from service, and ruggedness in thousands of applications where the going is tough. On mammoth tank retrievers and heavy multiple wheel drive army vehicles and on fast, dependable jeeps, Rzeppa Joints are doing a grand job.

They are working on the shuttle cars hauling coal from America's mines. They are installed on road scrapers, motor buses, tractors, brush clearing equipment, racing boats and cars.

The principles and construction features of this universal joint are discussed in a new catalog that will be sent you promptly on request.

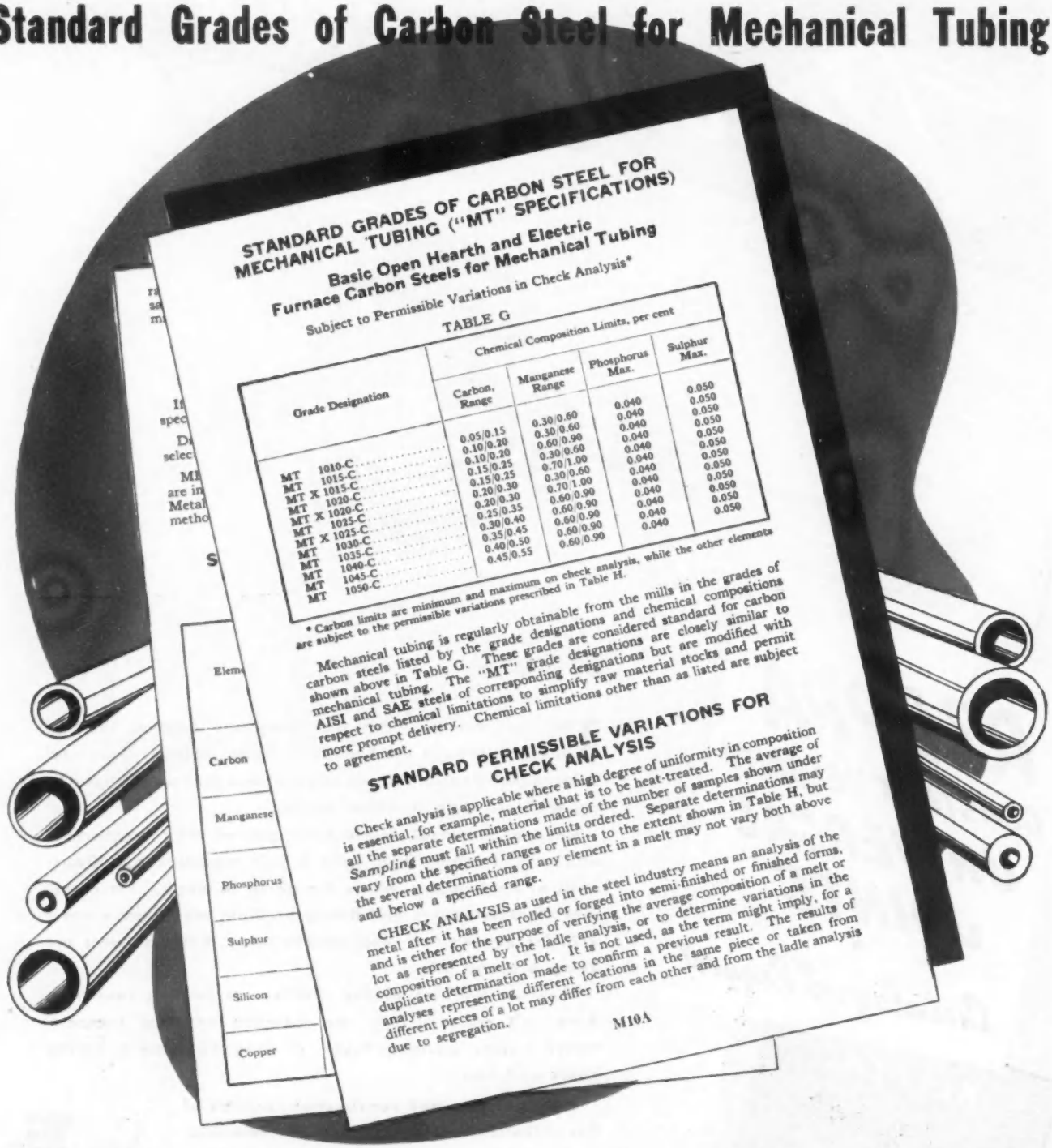
ARMY NAVY

The GEAR GRINDING MACHINE COMPANY

DETROIT 11 MICH.

Here are the "MT" SPECIFICATIONS . . .

Standard Grades of Carbon Steel for Mechanical Tubing



STANDARD GRADES OF CARBON STEEL FOR MECHANICAL TUBING ("MT" SPECIFICATIONS)

Basic Open Hearth and Electric Furnace Carbon Steels for Mechanical Tubing

Subject to Permissible Variations in Check Analysis*

TABLE G

Grade Designation	Chemical Composition Limits, per cent			
	Carbon, Range	Manganese Range	Phosphorus Max.	Sulphur Max.
MT 1010-C	0.05/0.15	0.30/0.60	0.040	0.050
MT 1015-C	0.10/0.20	0.30/0.60	0.040	0.050
MT X 1015-C	0.10/0.20	0.60/0.90	0.040	0.050
MT 1020-C	0.15/0.25	0.30/0.60	0.040	0.050
MT X 1020-C	0.15/0.25	0.70/1.00	0.040	0.050
MT 1025-C	0.20/0.30	0.30/0.60	0.040	0.050
MT X 1025-C	0.20/0.30	0.70/1.00	0.040	0.050
MT 1030-C	0.25/0.35	0.60/0.90	0.040	0.050
MT 1035-C	0.30/0.40	0.60/0.90	0.040	0.050
MT 1040-C	0.35/0.45	0.60/0.90	0.040	0.050
MT 1045-C	0.40/0.50	0.60/0.90	0.040	0.050
MT 1050-C	0.45/0.55	0.60/0.90	0.040	0.050

* Carbon limits are minimum and maximum on check analysis, while the other elements are subject to the permissible variations prescribed in Table H.

Mechanical tubing is regularly obtainable from the mills in the grades of carbon steels listed by the grade designations and chemical compositions shown above in Table G. These grades are considered standard for carbon mechanical tubing. The "MT" grade designations are closely similar to AISI and SAE steels of corresponding designations but are modified with respect to chemical limitations to simplify raw material stocks and permit more prompt delivery. Chemical limitations other than as listed are subject to agreement.

STANDARD PERMISSIBLE VARIATIONS FOR CHECK ANALYSIS

Check analysis is applicable where a high degree of uniformity in composition is essential, for example, material that is to be heat-treated. The average of all the separate determinations made of the number of samples shown under *Sampling* must fall within the limits ordered. Separate determinations may vary from the specified ranges or limits to the extent shown in Table H, but the several determinations of any element in a melt may not vary both above and below a specified range.

CHECK ANALYSIS as used in the steel industry means an analysis of the metal after it has been rolled or forged into semi-finished or finished forms, and is either for the purpose of verifying the average composition of a melt or lot as represented by the ladle analysis, or to determine variations in the composition of a melt or lot. It is not used, as the term might imply, for a duplicate determination made to confirm a previous result. The results of analyses representing different locations in the same piece or taken from different pieces of a lot may differ from each other and from the ladle analysis due to segregation.

M10A

Mechanical Tubing "MT" grade designations are closely similar to AISI and SAE steels of corresponding designations but are modified with respect to chemical limitations to simplify raw material stocks and permit more prompt delivery.

The "MT" standard grades are shown in the table above and chemical limitations other than as listed are subject to agreement. A full size copy of the bulletin above is available upon request or may be found in the Pittsburgh Mechanical Tubing Catalog.

PITTSBURGH STEEL COMPANY

1676 GRANT BUILDING PITTSBURGH 30, PA.

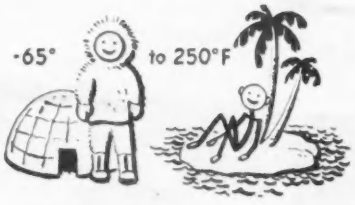
Aviation Maintenance Engineers

look like this . . . because

parts made of HYCAR have these . . .

RESISTANCE TO GASOLINE AND OIL

Hycar's resistance to petroleum products means that parts made from Hycar—gaskets, seals, hose, accumulator bags, and others that are exposed to petroleum products—won't swell, won't absorb petroleum and take on extra weight. Dimensional stability is assured. Maintenance and replacement time is practically eliminated.

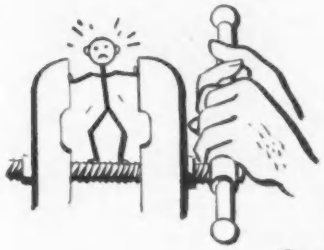


RESISTANCE TO COLD AND HEAT

Hycar compounds can be made to operate in temperatures as low as —65° F. or as high as 250° F., maintaining elasticity and resilience at the low temperatures, refusing to soften at the high. Parts last longer—little or no maintenance required.

RESISTANCE TO ABRASION

Abrasion resistance is considerably better than natural rubber and most other synthetics. Wear—and hence maintenance—is negligible, even in severe service.



RESISTANCE TO COLD FLOW OR CREEP

Even at elevated temperatures parts made from Hycar have a minimum tendency to cold flow or creep after they take permanent set from the applied loads. Hycar stays on the job—maintenance time goes down.

LIGHT WEIGHT

The specific gravity of crude Hycar is 1.00, 15% to 25% lighter than many other synthetic rubbers. Correspondingly lighter in compounded forms, Hycar parts reduce overall weight, permit more efficient operation.

THESE AND OTHER PROPERTIES OF HYCAR,

such as high tensile strength and good elongation, may be had in a wide variety of combinations to meet specific service conditions. Thus the right part for the right place can be obtained. And when the part is *right,* maintenance becomes a very minor problem. If you need help in solving your individual application problems, just write our Technical Service Staff. *Hycar Chemical Company, Akron 8, Ohio.*

Hycar

Reg. U. S. Pat. Off.

LARGEST PRIVATE PRODUCER OF BUTADIENE TYPE

Synthetic Rubber

Free—write for your copy of the new pocket-size Hycar Glossary of commonly used synthetic rubber terminology.

"MADE BY NATIONAL SCREW"

means *Quality Control*

Bench inspection.

Inspection under magnifying glass.

...1944 outlining procedures to be followed in establishing Quality Control Rating for the National Screw & Mfg. Company. The Air Technical Service Command is pleased to advise that Quality Control procedures at your facility are such as to warrant approval. Therefore, the National Screw & Mfg. Company has been listed on the Army Air Forces records as a Quality Control "APPROVED" facility.

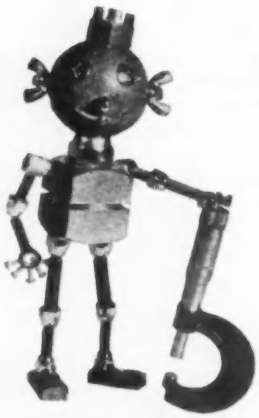
Checking pitch diameters with roller snap gauges.

Magnetic inspection by Magnaflux machine.

As a principal source of supply for aircraft fasteners, we have developed facilities for achieving tolerances formerly unheard of in bolts, nuts and screws.

There is only one way to insure rigid adherence to the quality required by the Air Forces, with a production of millions of parts daily. That is by a system of inspection that is complete and foolproof.

The excerpt reproduced above from a recent letter of formal approval from the Air Technical Service Command indicates how well National Screw has achieved this goal.



National HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

PROVING GROUNDS

In the flaming test of war on land, sea, and air—in 80 types of Allied war planes; in submarines, destroyers, escort and landing craft; in tanks, trucks, and jeeps—American Hammered Piston Rings prove their absolute correctness for every purpose. Koppers Company, Inc., American Hammered Piston Ring Division, Baltimore, Maryland.

WAR PLANES USING AMERICAN HAMMERED PISTON RINGS:

A-20 Havoc
A-22 Maryland
A-24 Dauntless
A-25 Shrike
A-29 Hudson
A-30 Baltimore
A-31 Vengeance
A-34 Buccaneer
A-36 Invader
B-17 Flying Fortress
B-18 Bolo
B-23 Dragon
B-24 Liberator
B-25 Mitchell
B-26 Marauder
B-29 Superfortress
B-34 Ventura
C-43 Traveler
C-45A Voyager
C-46 Commando
C-47 Skytrain
C-53 Skytrooper
C-54 Skymaster
C-56 Lodestar
C-61 Forwarder
C-69 Constellation
C-76 Caravan
C-87 Liberator Express
J-4-F Widgeon
L-1 Vigilant
L-2 Hedgehopper
L-3 Grasshopper
L-4 Grasshopper
L-5 Sentinel
O-52 Owl
P-40F Warhawk
P-43 Lancer
P-47 Thunderbolt
P-51B Mustang
P-61 Black Widow
P-66 Vanguard
AT-6 Texan
AT-7 Navigator
AT-8 Bobcat
AT-9 Jeep
AT-10 Wichita
AT-11 Kansan
AT-13 Yankee Doodle
AT-14 Yankee Doodle
AT-15 Crewmaker
AT-17 Bobcat
AT-19 Reliant
BT-13 Valiant
BT-15 Valiant
PT-13 Kaydet
PT-17 Kaydet
PT-19 Cornell
PT-22 Recruit
PT-26 Cornell
F2A Buffalo
F4F Wildcat
F4U Corsair
F6F Hellcat
N2T Tutor
OS2U Kingfisher
PBM Mariner
PBY Catalina
PB2Y Coronado
SB2A Bermuda
SB2C Helldiver
SB2U Vindicator
SBD-3 Dauntless
SO3C Seagull
SNC Falcon
SNJ Texan
TBD Devastator
TBF Avenger
JRM-1 Mars
YO-51 Dragonfly
Sikorsky Helicopter

F4U CORSAIR DEATH TO A JAP DIVE BOMBER

American Hammered Piston Rings

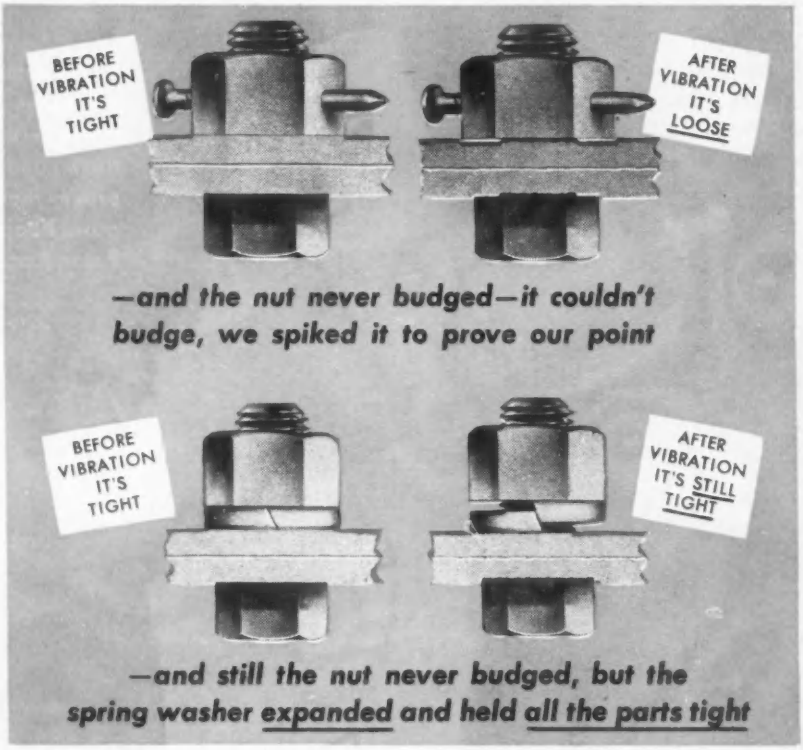
ARMY E NAVY

A KOPPERS PRODUCT

Don't Let a Nut Mislead You

Even if the nut never budges on the bolt—all other parts of bolted assemblies inevitably loosen under vibration. Bolts stretch, metal rubs metal, rust and scale pulverize—all tending to loosen the entire assembly unless a strong spring washer is used to expand and hold all parts tight.

So whether you use a regular standard nut or one of the many fixed or lock-nuts you must use a powerful spring washer. The spring expands and compensates for later inevitable wear. No device except a long-range spring washer can expand and do this job that is so essential to bolted security.


BEFORE VIBRATION IT'S TIGHT
AFTER VIBRATION IT'S LOOSE
—and the nut never budged—it couldn't budge, we spiked it to prove our point
BEFORE VIBRATION IT'S TIGHT
AFTER VIBRATION IT'S STILL TIGHT
—and still the nut never budged, but the spring washer expanded and held all the parts tight

Our Kantlinks conform to Government Specifications BECX 1-2-3, AN 935, and drawing 12-Z-22.

Originators of KANTLINK the long-range spring washer

NATIONAL LOCK WASHER COMPANY

NEWARK, N. J., U. S. A.

YOU CAN NOW BUY EFFICIENT, YET INEXPENSIVE RETAINING RINGS THAT SAVE METAL AND MONEY FOR YOU

These artificial shoulders are used more and more widely to hold many types of mechanisms in place. They are less expensive than big shoulders, and more efficient also than cotter pins, etc.

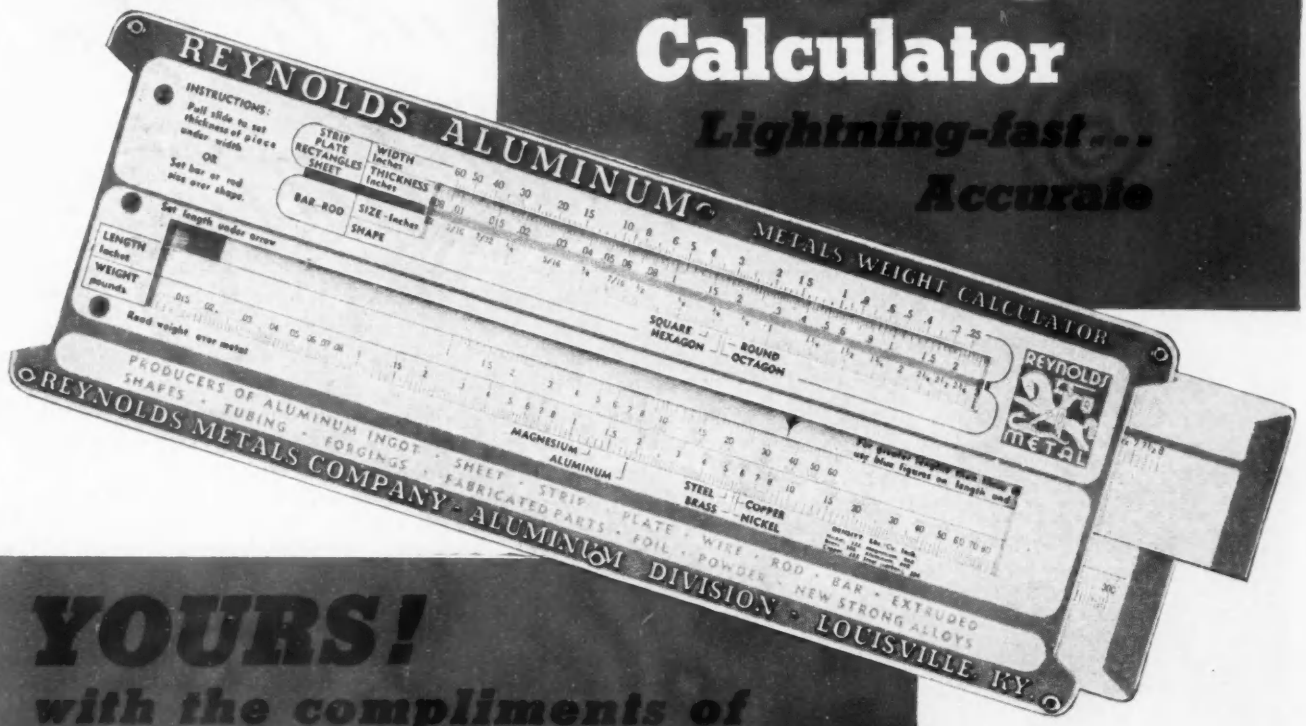
Examine your machines and metal products to see where retaining rings can save you dollars and metal.

NATIONAL RETAINING RINGS

NEW!

Metals Weight Calculator

Lightning-fast... Accurate


REYNOLDS ALUMINUM
METALS WEIGHT CALCULATOR
INSTRUCTIONS:
STRIP PLATE RECTANGLES SHEET
WIDTH inches
THICKNESS inches
BAR-ROD
SIZE-inches
SHAPE
LENGTH inches
WEIGHT pounds
SQUARE HEXAGON
ROUND OCTAGON
REYNOLDS METAL
MAGNESIUM ALUMINUM
STEEL BRASS
COPPER NICKEL
PRODUCERS OF ALUMINUM INGOT · SHEET · STRIP · PLATE · WIRE · ROD · BAR · EXTRUDED SHAPES · TUBING · FORGINGS · FABRICATED PARTS · FOIL · POWDER · NEW STRONG ALLOYS
REYNOLDS METALS COMPANY · ALUMINUM DIVISION · LOUISVILLE, KY.

YOURS!

with the compliments of

REYNOLDS ALUMINUM

Here is one of the handiest calculating devices ever developed.

All the answers INSTANTLY. Everyone who works with metals will find this instrument invaluable.

It does the work for you, saves up to 90% of the time and effort on weight calculation. Just make the settings—then read the results. Serves equally well with aluminum, steel, brass, copper, magnesium, and nickel.

The Reynolds *Metals Weight Calculator* is a convenient, durable, vestpocket-sized instrument, measuring only 3"x 8¼". With a flip of the finger, weights are calculated from cross-sectional dimensions and length as accurately as from published tables of theoretical weights. It can also be used to determine lengths from cross-sectional dimensions and weights.

Scales included are sheet, strip and plate; round wire and rod; square, hexagonal, octagonal and rectangular bar; tubing; and sheet circles. Range of instrument—from .0006 lbs. to 3000 lbs.—from an infinitesimal-sized piece of metal to a giant bar.

If you work with metals, you will find this Reynolds *Metals Weight Calculator* very helpful. Mailed post-free upon request, in a protective wrapping.

A REAL TIME-SAVER. Engineers report that, besides facilitating absolute accuracy, the Reynolds Metals Weight Calculator saves up to 90% of the time ordinarily required to consult tables and make calculations.

OUR SUPPLY IS LIMITED; SO PLEASE FILL IN AND

MAIL TODAY

REYNOLDS METALS COMPANY
Aluminum Division
2503 South Third Street
Louisville, Kentucky

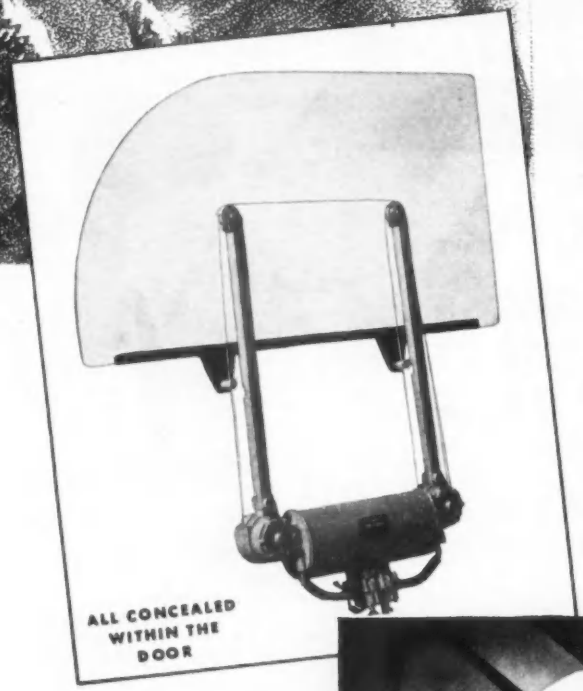
Please send me, without charge, a Reynolds *Metals Weight Calculator*.

Name_____ Title_____

Company_____

Street_____

City_____ Zone_____ State_____



WITH THE *Touch of a Button*

. . . control of car windows will become a reality in postwar model motor cars.

The Lift-O-Matic—a power-actuated system—permits the full opening or closing of a window in a split-second.

Vacuum, in combination with atmospheric pressure — a power so fully developed in wartime — is the force used to insure this speedy movement of the glass and the quick adjustment of the window in any desired position within the range of movement.

Economical in application, economical in first installation cost and, what is very important, economical from the standpoint of operation and service, the Lift-O-Matic is certain to be identified as one of the notable advancements in motor car operation.

From the standpoint of *safety*, power-actuated motor car windows contribute materially in avoidance of driving hazards, while providing comfort and added pleasure in car operation.

Concealed within the door hinge, a conduit conveys the vacuum power to the simple cylinder power unit thru which the lifting and lowering movement is transmitted to the window glass over roller-bearing sheaves, over which flexible aeroplane control cables perform as an endless belt. Any of these cables has lifting power sufficient to support the weight of a car engine. They are thoroughly dependable. In addition to test during the war years in their universal application in aeroplane control work of fighter and bombing planes, the adaptation to Trico's window controls is the result of extensive specific test.

The Lift-O-Matic is a sturdy instrument which not only lifts and lowers but locks the window in any desired position to resist any prying movement downward, still permitting manual movement of the glass to a closed position even when the power is disconnected. The locking device functions in the Lift-O-Matic whether or not power is applied.

Made by TRICO . . . Manufacturers of automatic windshield wipers used as standard on millions of cars for 25 years.

BUY WAR BONDS NOW . . . AND PLAN FOR YOUR NEW CAR OF TOMORROW.

TRICO PRODUCTS CORPORATION, Buffalo 3, New York

1 PORUS-KROME applied to the cylinder walls of gasoline and Diesel engines multiplies the life of the cylinders from 4 to 20 times.

2 PORUS-KROME on the cylinder walls multiplies the life of the ordinary piston rings from 3 to 5 times.

3 PORUS-KROME, with its thousands of tiny pores and channels which hold lubricating oil and feed it back as needed, improves lubrication and holds lubricating oil consumption at a constant low level.

4 PORUS-KROME and piston rings wear so slowly that high power development is maintained for many more hours . . . many more miles . . . than with ordinary cylinders.

5 PORUS-KROME means greater engine reliability because it reduces scoring and scuffing and the risk of piston seizure and because it cuts down the number of overhauls caused by cylinder and ring wear.

All of these advantages add up to a substantial saving in engine operating costs.

VAN DER HORST

U. S. PATENTS 2,048,578 AND 2,314,604

PORUS - KROME

Good for the Life of your Engines

* PORUS-KROME is pure, hard chromium which is applied to cylinder bores by the patented Van der Horst process. It has tiny pores and channels in its surface which serve as reservoirs for lubricating oil, feeding it back as needed. It reduces corrosion and wear and multiplies cylinder life 4 to 20 times.

VAN DER HORST CORPORATION OF AMERICA OLEAN · NEW YORK CLEVELAND 11 · OHIO

AN AFFILIATE OF DRESSER INDUSTRIES

Adaptability . . .

Long years of experience have enabled The Chicago Screw Company to adapt itself to handle any of your screw machine products and special cold upset products, including all secondary operations, regardless of size, shape or form, and in quantities of hundreds or millions.

In resuming post-war manufacture—we urge you NOW to choose "Chicago Screw", the outfit with the "Know How" for your precision requirements.

THE CHICAGO SCREW CO.

1026 So. Homan Avenue Chicago 24, Ill.

Instruments

OF WAR AND PEACE!

These fittings don't look deadly, do they? But because they are indispensable to virtually every unit of the nation's mobile fighting machines—whether on land, sea, or in the air—they are as effective equipment as exists in the war!

Throughout the war, the four plants of The Weatherhead Company have produced these vital parts at the rate of more than a million a day—and will be prepared to devote their entire facilities to peacetime production in many fields when the Day of Victory comes.

FREE: *Write on company letterhead for "Seeds Of Industry"—a history of The Weatherhead Company, its many facilities and diversified products.*

Look Ahead with **Weatherhead**

THE WEATHERHEAD COMPANY, CLEVELAND, OHIO

Manufacturers of vital parts for the automotive, aviation, refrigeration and other key industries.

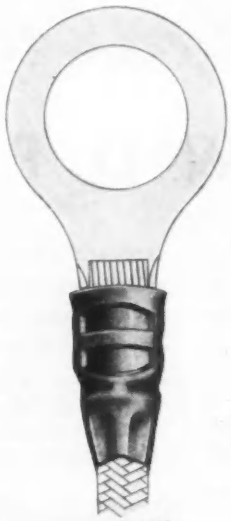
Plants: Cleveland, Columbia City, Ind., Los Angeles
Canada—St. Thomas, Ontario

AMP

PRE-INSULATED

DIAMOND-GRIP

TERMINALS



It's pre-insulated! The insulation is bonded to the terminal — it will not slip — cannot be accidentally removed. The AMP Pre-insulated terminal is delivered to you ready to crimp and use.

Eliminate these unnecessary time consuming and costly operations:

1 Buying, stocking, identifying and cutting insulation sleeving as a separate item in separate sizes.

2 Selecting and slipping the correct insulation sleeving over the wire before crimping, and over the terminal after installation.

AMP Pre-insulated Terminals are quickly installed with one-operation AMP hand tools (or power press dies). You have the advantage of visual inspection of the finished crimp.

Identification of wire sizes is almost instantaneous — Red insulation for 22 to 18, Blue for 16 to 14, and Brown for 12 to 10.

The installed AMP Pre-insulated Terminal costs you less — Write for Bulletin 29A.

"Precision Engineering Applied to the End of a Wire"

TWO MAJOR

AMP

ACHIEVEMENTS

IN *Solderless* WIRING

AMP

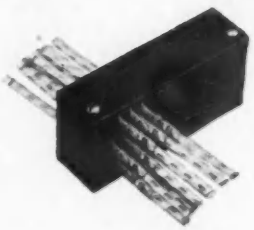
KNIFE-DISCONNECT SPLICING TERMINALS

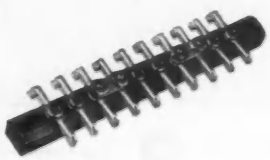
and

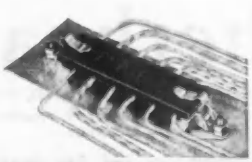
The New...

AMP

SIMPLIFIED WIRING







The basic design of the AMP Knife-Disconnect Splicing Terminal is as simple as it is revolutionary. The identical ends are joined in perfect 4-point electrical connection by a single knife-switch wiping action. The tensile strength of the splice is greater than that of the wire itself. The connection is maintained until intentionally taken apart.

On this inherently superior principle, a complete simplified wiring system has been developed and proved by Aircraft-Marine Products. Adaptations include T-Link, Y-Link, Cross Link and Stud Tab connectors; connector strips, multiple connectors and connector blocks; also disconnect integral stampings as part of small electrical assemblies such as switches, fuses, relays, etc.

The "AMP Simplified Wiring" bulletin is yours on request. Send for a copy — it will interest you.

Trademark Reg. U. S. Pat. Off.

AIRCRAFT-MARINE PRODUCTS INC.

AMP

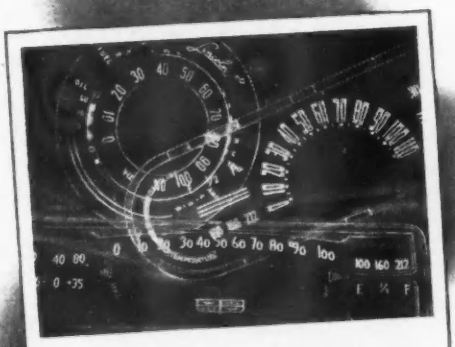
SOLDERLESS WIRING DEVICES

AIRCRAFT-MARINE PRODUCTS INC. 1521-55 NORTH FOURTH STREET HARRISBURG, PENNSYLVANIA

A & M ACCESSORIES, LTD., TORONTO, ONTARIO, CANADA

For that "Touch of Tomorrow" on Postwar Models . . .

Plexiglas



• Edge-lighted dials of transparent PLEXIGLAS are among scores of automotive applications. Size, shape, color, lettering and marking can be designed to harmonize with the interior styling.

• New styling where it's quick to catch the customer's eye. Colorful horn buttons of PLEXIGLAS with three-dimensional designs are another adaptation of "aviation's standard transparent plastic."

• To add that "touch of tomorrow" to postwar models, take advantage of the crystal clarity and brilliant lustre of PLEXIGLAS. This transparent plastic adapts itself to scores of applications including horn buttons, radiator ornaments, radio grilles, instrument and clock dials, escutcheons and body hardware.

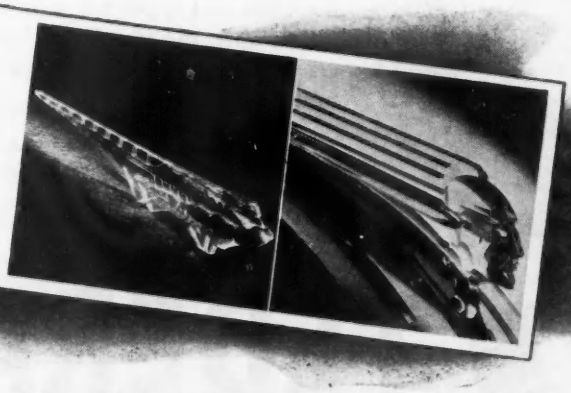
Numerous prewar uses of PLEXIGLAS in motor cars proved the permanence of its transparency, which has been conclusively confirmed by three years of combat service on every type of Army and Navy plane.

The motor car industry already knows from experience how easily PLEXIGLAS can be molded in mass-production. Postwar models will offer many opportunities to use its gem-like beauty, its ability to pipe light and its adaptability to three-dimensional effects. *Specify* PLEXIGLAS *moldings on your blueprints.*

For additional information, telephone or write to our Detroit Representative: W. E. Biggers—619 Fisher Building—Madison 1500.

***Only Rohm & Haas Makes* PLEXIGLAS**

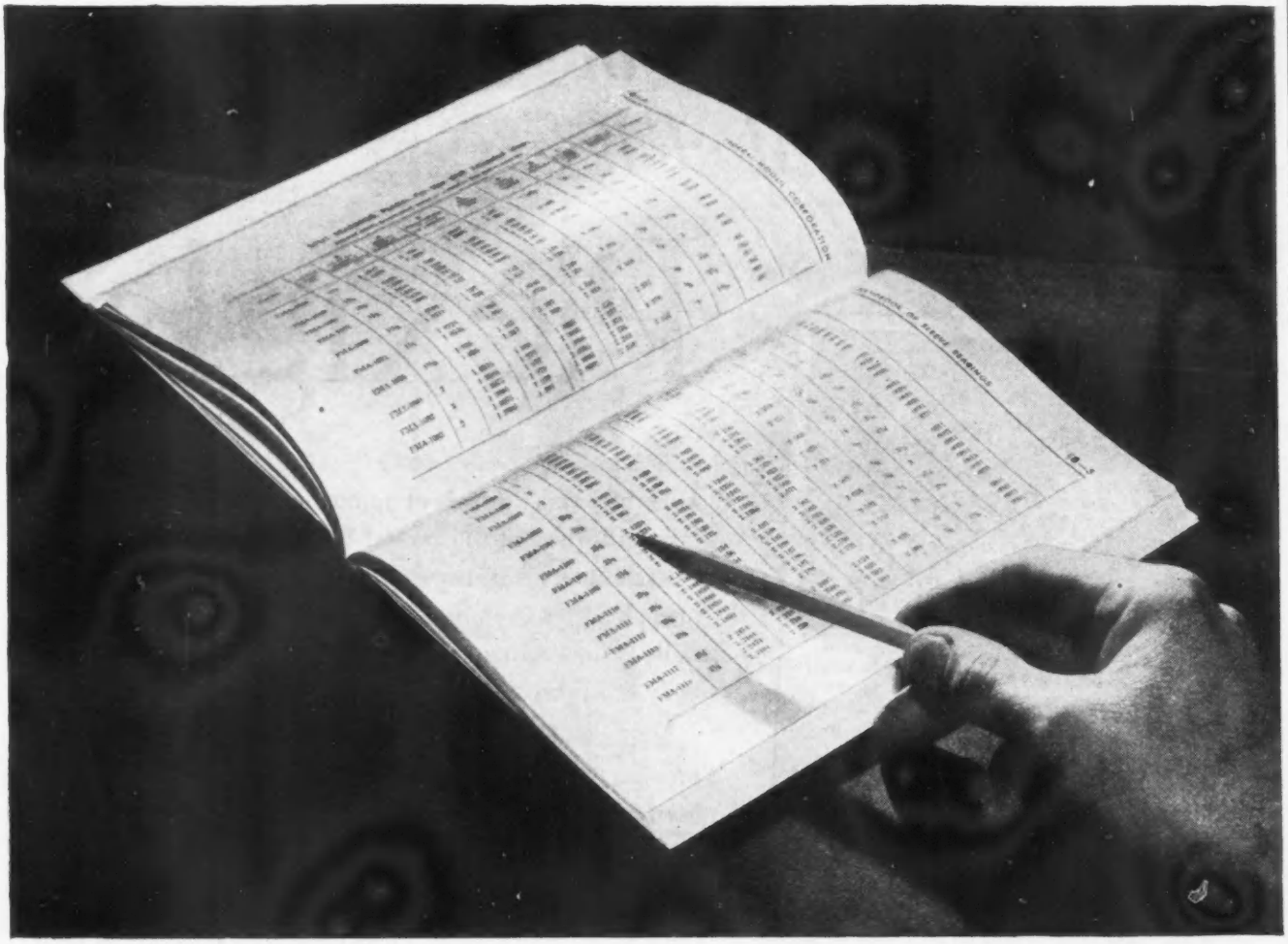
• From radiator ornament to rear light nameplate, PLEXIGLAS will put sparkle in postwar models. So permanent is this transparent plastic it may be used to embellish exteriors as well as interiors.



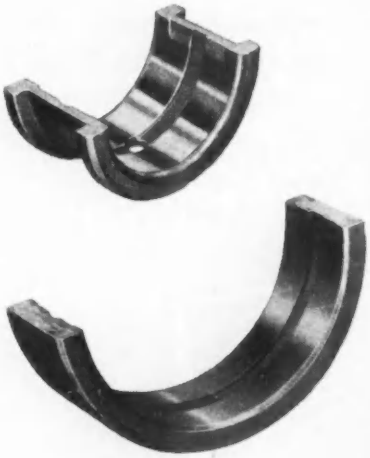
PLEXIGLAS is the trade-mark, Reg. U.S. Pat. Off., for the acrylic resin thermoplastic sheets, rods and molding powders manufactured by Rohm & Haas Company

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA, PA.

Manufacturers of Chemicals including Plastics . . . Synthetic Insecticides . . . Fungicides . . . Enzymes . . . Chemicals for the Leather, Textile and other Industries

A Practical Guide to Sleeve Bearing Specifications

Enabling Engineers to Meet Special Needs at Lower Tooling Costs



Use of the "Handbook of Sleeve Bearings" can be invaluable in permitting you to design into your product, bearings for which major tooling is already available. In addition to tabulation of the sizes and types for which tooling is available, the Handbook briefly covers sleeve bearing materials and the fundamentals of design.

The design engineer can save both time and money by the use of this reference book—time in production, as well as in design, and the higher costs of major tooling ordinarily required. Now is the time to become familiar with the advantages of this service, already widely used. This book is supplied on request to Engineering Departments of companies whose product includes sleeve type bearings and precision bushings in its construction. A request on your company letterhead will receive prompt attention.

FEDERAL MOGUL CORPORATION • 11029 Shoemaker, Detroit 13, Michigan

FEDERAL-MOGUL

Silent FEDERAL Mogul **SLEEVE BEARINGS**

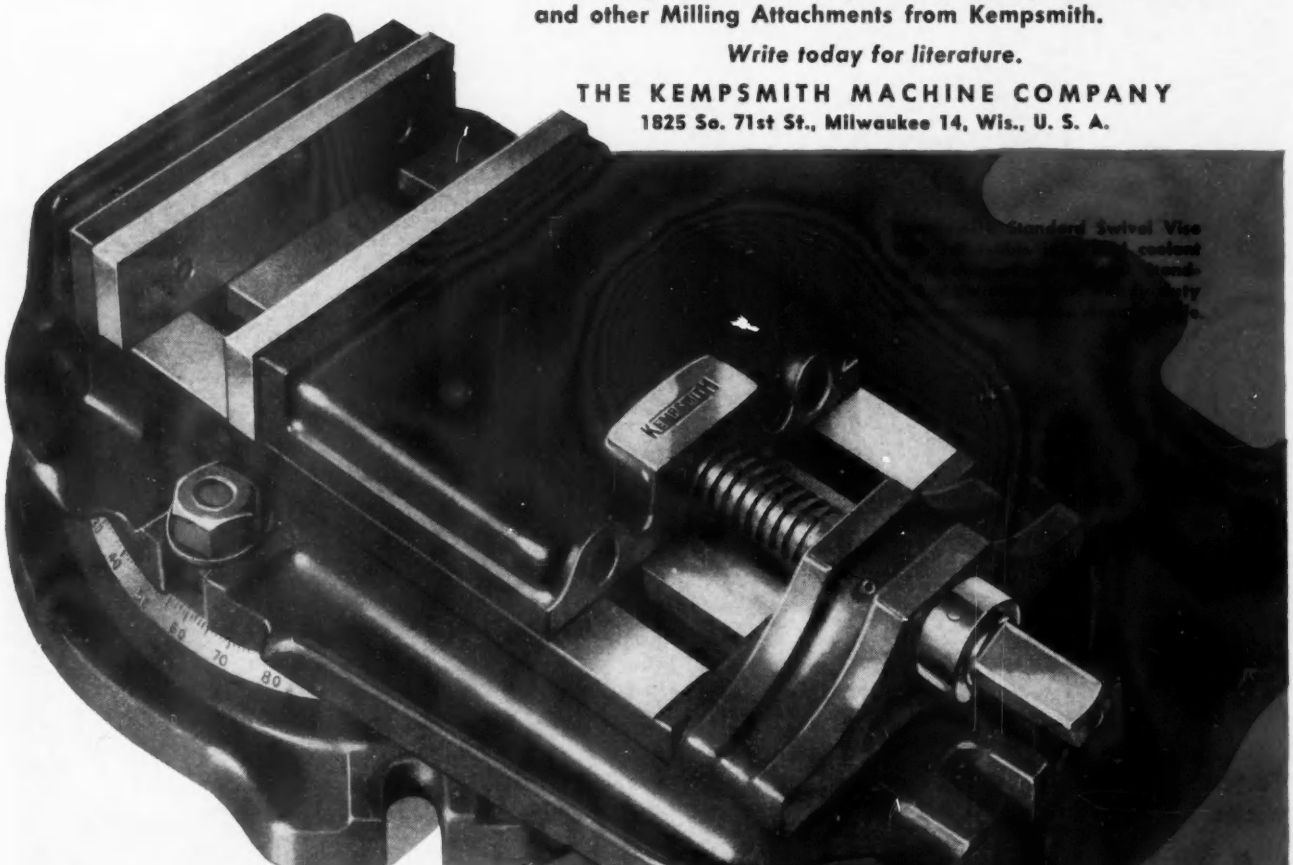
Simple as... ...YET THEY MUST BE *Right!*

Milling Machine Vises may look like simple "gadgets" — but actually they are precision tools, with operating surfaces accurately ground to size and squareness and built to take hard, everyday punishment.

It is only reasonable that a manufacturer of milling machines is best equipped to produce milling machine vises. Kempsmith has specialized in building precision-built milling machines and equipment for *more than a half-century*. That's why you'll find it pays to buy Milling Machine Vises and other Milling Attachments from Kempsmith.

Write today for literature.

THE KEMPSMITH MACHINE COMPANY
1825 So. 71st St., Milwaukee 14, Wis., U. S. A.



Vises BY KEMPSMITH

White Today

Bulletin No. 117, describing Kempsmith Vises, is just off the press. Fill in and mail coupon for your copy.

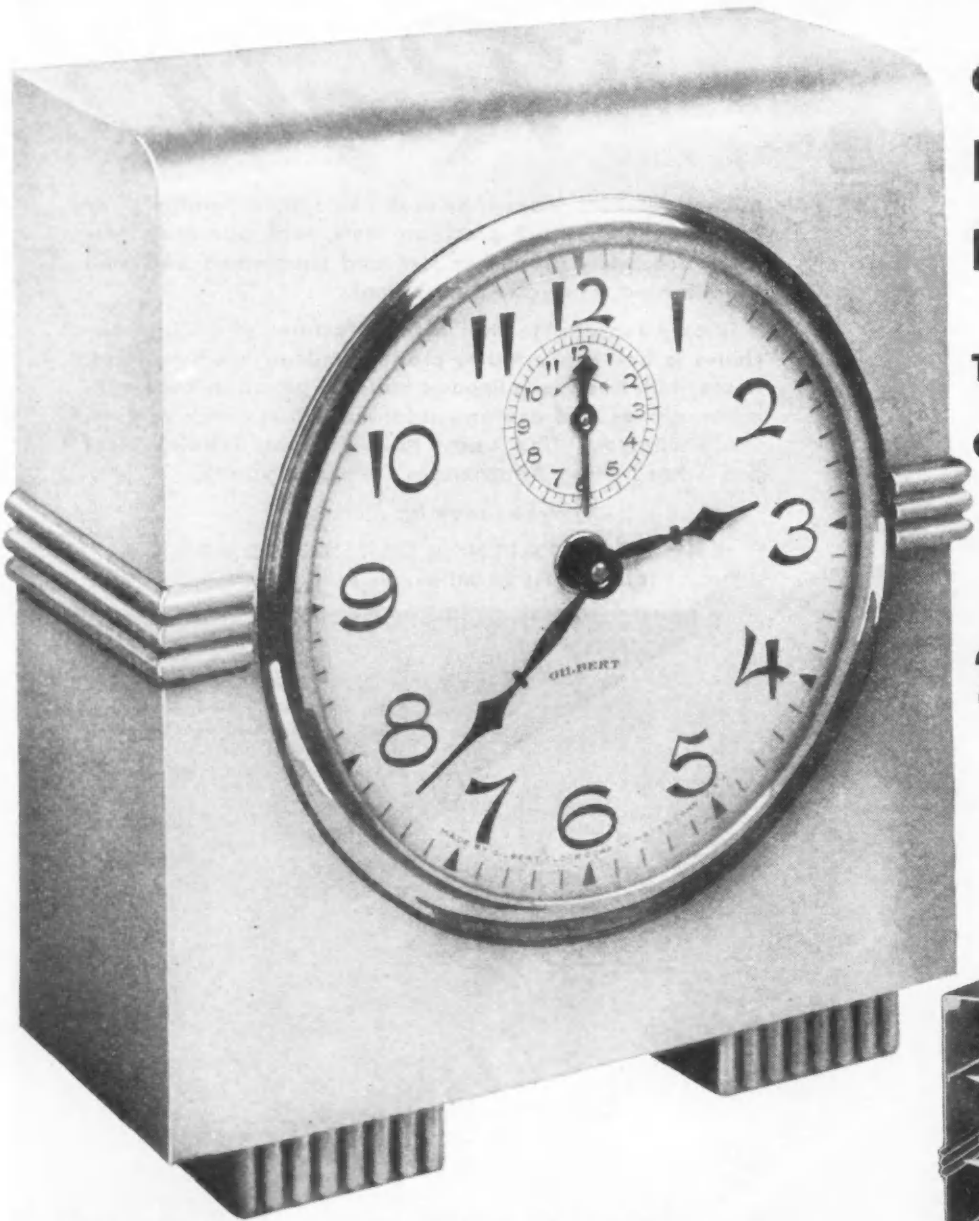
Precision Built Milling Machines Since 1888

KEMPSMITH—Yes, I would like to receive a copy of Bulletin No. 117. Mail to:

Name..... Title.....

Firm..... Address.....

For Beauty of Design . . . .



and Low Cost Production

This Satin Finish CHROME-PLATED CLOCK CASE was

Die-Cast

CDC

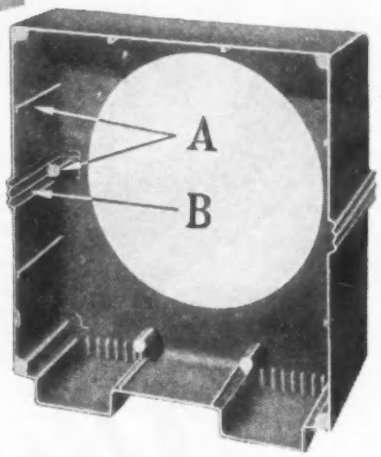
To follow the design as desired and remain competitive in price, a zinc die casting was decided upon for the following reasons:

FIRST—The designer's idea was made possible *only* by manufacturing the case in one pice through *die casting.*

SECOND—The surface finish of the casting required only a light buffing previous to plating.

THIRD—Wall thickness of the case was held below .040" to keep the price competitive.

FOURTH—Structurally the die casting incorporated, through the use of bosses, the elimination of riser blocks and other items necessary to the final assembly of the clock works.



The above illustration shows:

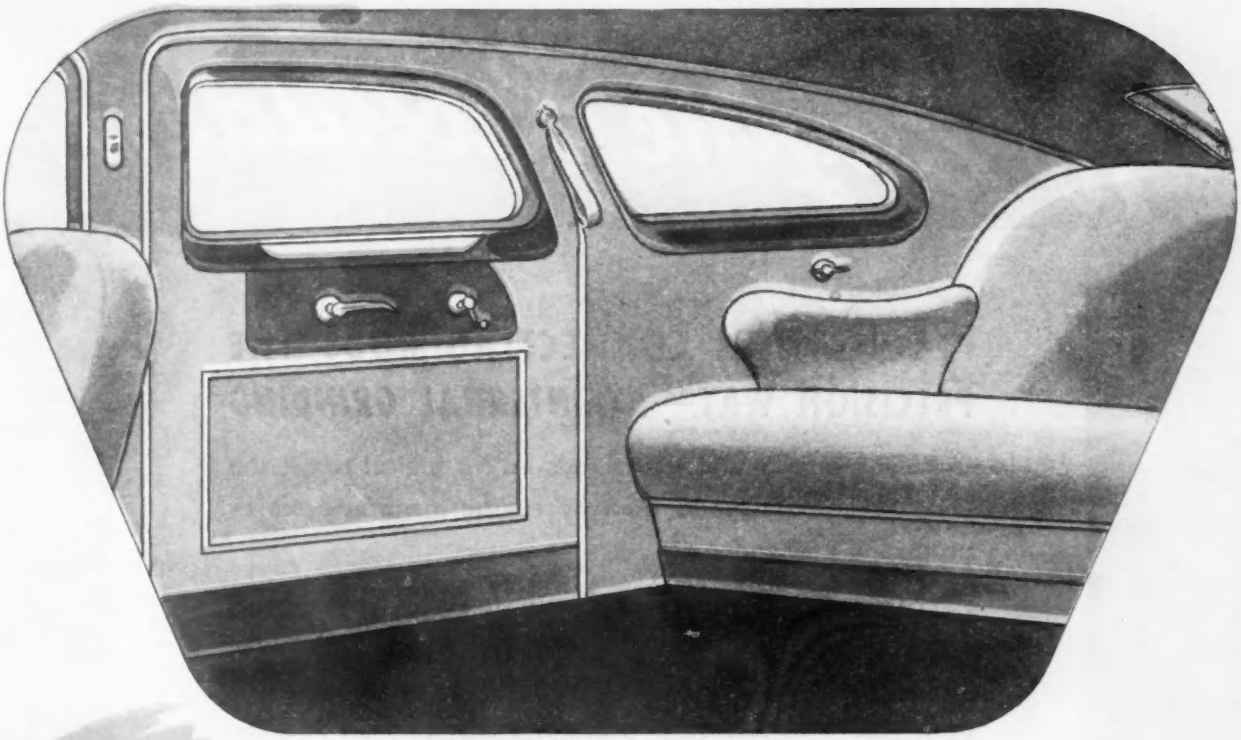
A Bosses that eliminate riser blocks to save time in final assembly.

B Ornamental side ribs made possible through die casting and cored-out to save material.

CONTINENTAL DIE CASTING CORPORATION

SUBSIDIARY OF F. L. JACOBS CO.

9615 GRINNELL AVENUE DETROIT 13, MICHIGAN



Washable Hard Surface Interiors

EASILY KEPT SPOTLESS

Formica motor car interiors can compete with anything in sales-making beauty. They delight the feminine eye. And no matter how hard the car is used, it is not difficult to keep Formica fresh and new.

The non-absorbent surface is as difficult to stain as glass, and easily washed with soap and water or cleaned with solvents.

It is available in attractive or dainty fabric patterns that are most acceptable to women.

Formica offers the chance to introduce into your new car a cleaner and more sanitary interior with a striking and thoroughly modern beauty.

Application is no problem. Every body engineer knows ways to do it without additional equipment or tooling. In other words this big improvement is ready to go—in your first new models.

ARMY E NAVY

FORMICA

THE FORMICA INSULATION COMPANY • 4612 SPRING GROVE AVENUE • CINCINNATI 22, OHIO

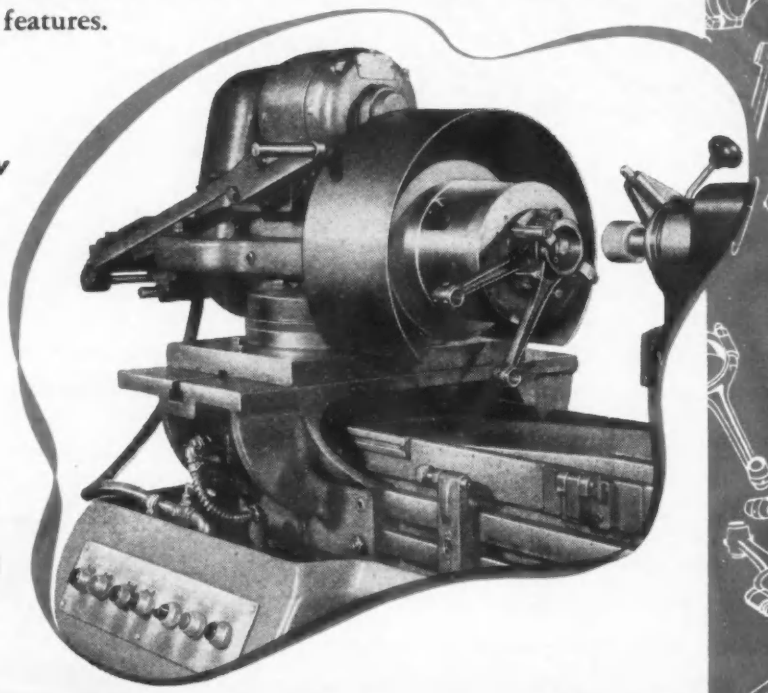
To Engine Rebuilders

RECONDITION CONNECTING RODS THE PRECISION WAY—*BY INTERNAL GRINDING*

In reconditioning connecting rods isn't it logical to use the same precision method used by engine manufacturers in producing new rods?

The Sav-Way Spitfire Hydraulic Internal Grinder was built specifically to give engine rebuilders the same degree of accuracy, high finish, and production speed demanded by engine manufacturers. Quick and easy to load and unload; easy to change over from one job to another; extremely fast traverse. Equipped with the famous Gold Seal Grinding Spindle, automatic adjustable crossfeed, and dozens of other outstanding features.

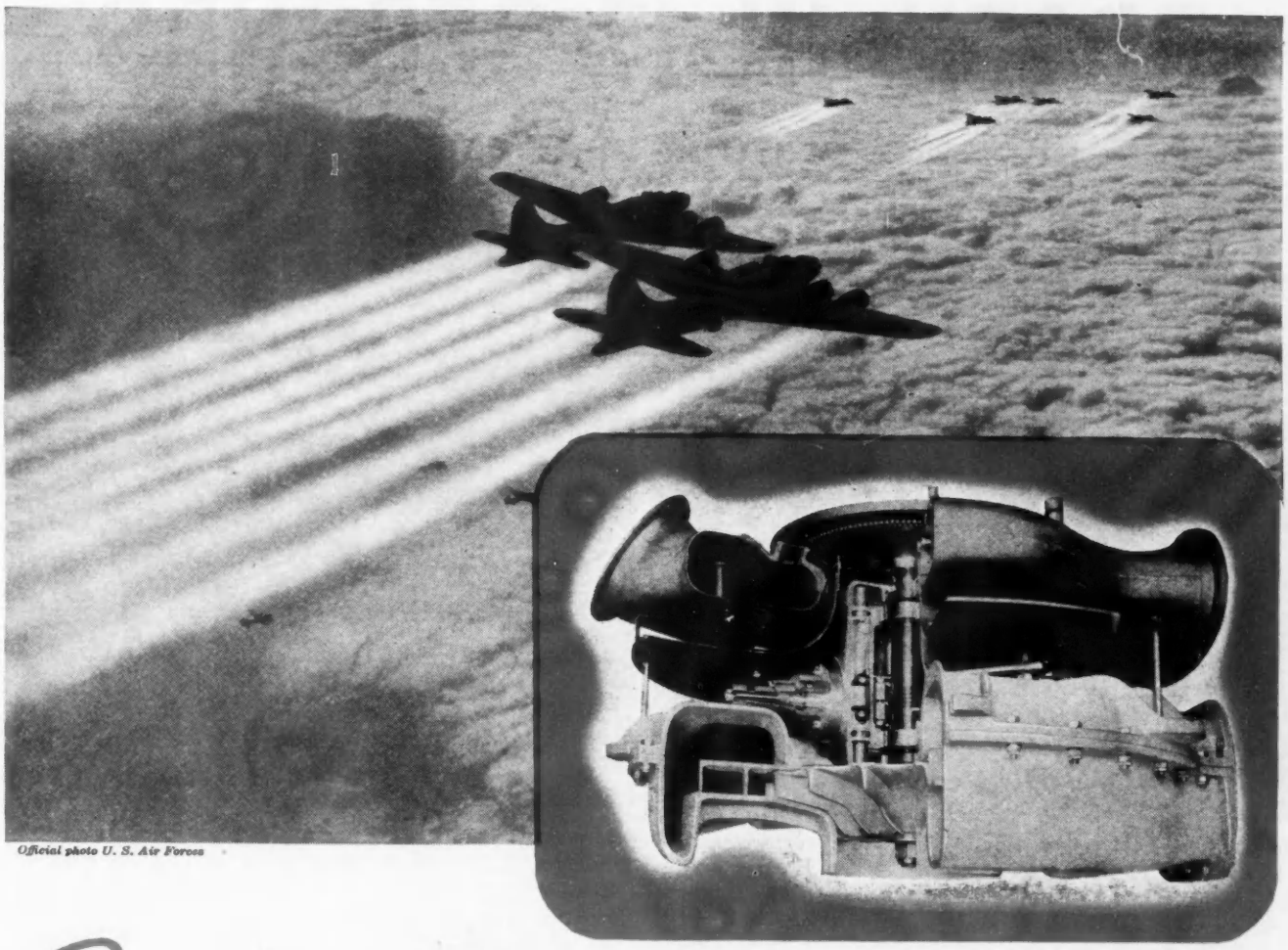
Surprisingly Low in Price



Actual Photographs, Specifications, and Prices Will Be Mailed Upon Request

Sav-Way INDUSTRIES
** Machine Tool Division **
BOX 117, HARPER STATION, DETROIT 13, MICHIGAN

BUILDERS OF HAND AND HYDRAULIC INTERNAL GRINDERS • PRODUCERS OF GOLD SEAL SPINDLES • PLUG GAGES • MICROMETER CHECKERS PRECISION AIRCRAFT, AUTOMOTIVE, AND ORDNANCE PARTS



Official photo U. S. Air Forces

Breathing Fire at 65 below Zero

At eight miles up, where the air is too thin to sustain combustion, it must be compressed and crammed down the airplane engine's windpipe. That's the job of the ingenious device shown above—the turbosupercharger.

One half is a rotary compressor—the other half a gas turbine, driven at some 30,000 r.p.m. by the flaming exhaust gas from the engine.

Simple? How about severe thermal stresses created by hot gas at 1500° expanding the metal from the inside and frigid air at 65 below zero contracting from the outside? What of tons of centrifugal force trying to pull the rotor apart—to say nothing of corrosion and the scouring action of the rushing gas?

No wonder that Republic Electric Furnace Steel is used for the shaft—and in stainless grade for the turbine housing and rotor wheel. The tiny turbine blades welded to the rotor wheel are electric furnace steel, too.

It's in difficult uses like this that Republic Electric Furnace Steels demonstrate their ability to hit narrowest specification marks for physical, chemical, hardenability and performance values through "targeting" possible only in electric furnace melting.

It's in such vital applications that the slight extra cost of Republic Electric Furnace Steels is cheap protection against hidden imperfections—insurance against premature, dangerous and costly failure.

Republic—world leader in electric furnace steel-making—is ready to tell you how these same steels can help YOU achieve top quality in YOUR peacetime products—how their consistent uniformity, cleanliness and soundness will enable you to obtain maximum results from mass production methods. Write us.

REPUBLIC STEEL CORPORATION

Alloy Steel Division • Massillon, Ohio

GENERAL OFFICES • CLEVELAND 1, OHIO

Berger Manufacturing Division • Culvert Division
Niles Steel Products Division • Steel and Tubes Division
Union Drawn Steel Division • Truscon Steel Company
Export Department: Chrysler Bldg., New York 17, N. Y.

REPUBLIC

—Leader in the Production of

ELECTRIC FURNACE STEELS

"QUALITY" steels . . . alloy . . . stainless

READY—IN 17 SECONDS

REPRODUCTIONS OF YOUR DRAFTSMEN'S DRAWINGS, TYPED MATERIAL, OFFICE FORMS

In this case, the operator is feeding a draftsman's pencil drawing, size 17" x 22", and a piece of sensitized paper into the machine. Smooth-running conveyor belts speed both materials around the printing cylinder . . . after which the drawing is automatically released, and the exposed paper goes up and across the dry-developing tank.

Here comes the Ozalid print . . . an exact duplicate—not a negative, of the original. You'll find it dry, ready for immediate use. And there's a very unique reason for the short time required—only 17 seconds . . . and for the fact that the print has black, or red, or blue lines on a white background—whichever color was desired.

WHY YOU MAKE PRINTS WITH THIS SPEED AND VERSATILITY

THE ANSWER is in OZALID DRY DEVELOPMENT . . . and what it has allowed designers and chemists to do.

Since only one developing operation is employed, the design of an Ozalid machine is extremely simplified. *So* compact in size you can install it in a corner of the drafting room or office. *So* easy to understand that any inexperienced person can quickly learn to turn out prints with maximum efficiency—using cut sheets or roll stock.

Also consider the amazing line of sensitized materials which react only to the *dry* principle . . . and offer this choice whenever you want to reproduce anything drawn, typed, printed, or photographed on translucent material:

- **Black, Red, Blue Line** standard papers which allow you to assign identifying colors to prints of different departments, to distinguish checked from unchecked prints, etc.
- **Transparent Papers, Cloths, Foils** which you use to produce Intermediate Originals and Composite Prints or to reclaim worn or soiled drawings.
- **Opaque Cloths** which give you prints of exceptional durability.
- ***NEW* Dryphoto Papers** which produce beautiful reproductions with all the halftone details, from photographic film-positives or perspective drawings.

See all of these Ozalid Prints yourself—and learn the complete story.

Write for "Simplified Printmaking" today.

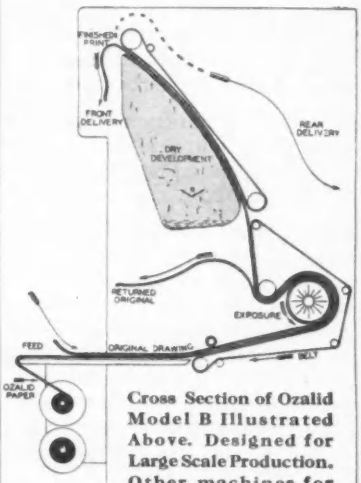
ARMY E NAVY

OZALID

Division of
General Aniline and Film Corporation

Johnson City, New York

Ozalid in Canada—
Hughes-Owens Co., Ltd., Montreal

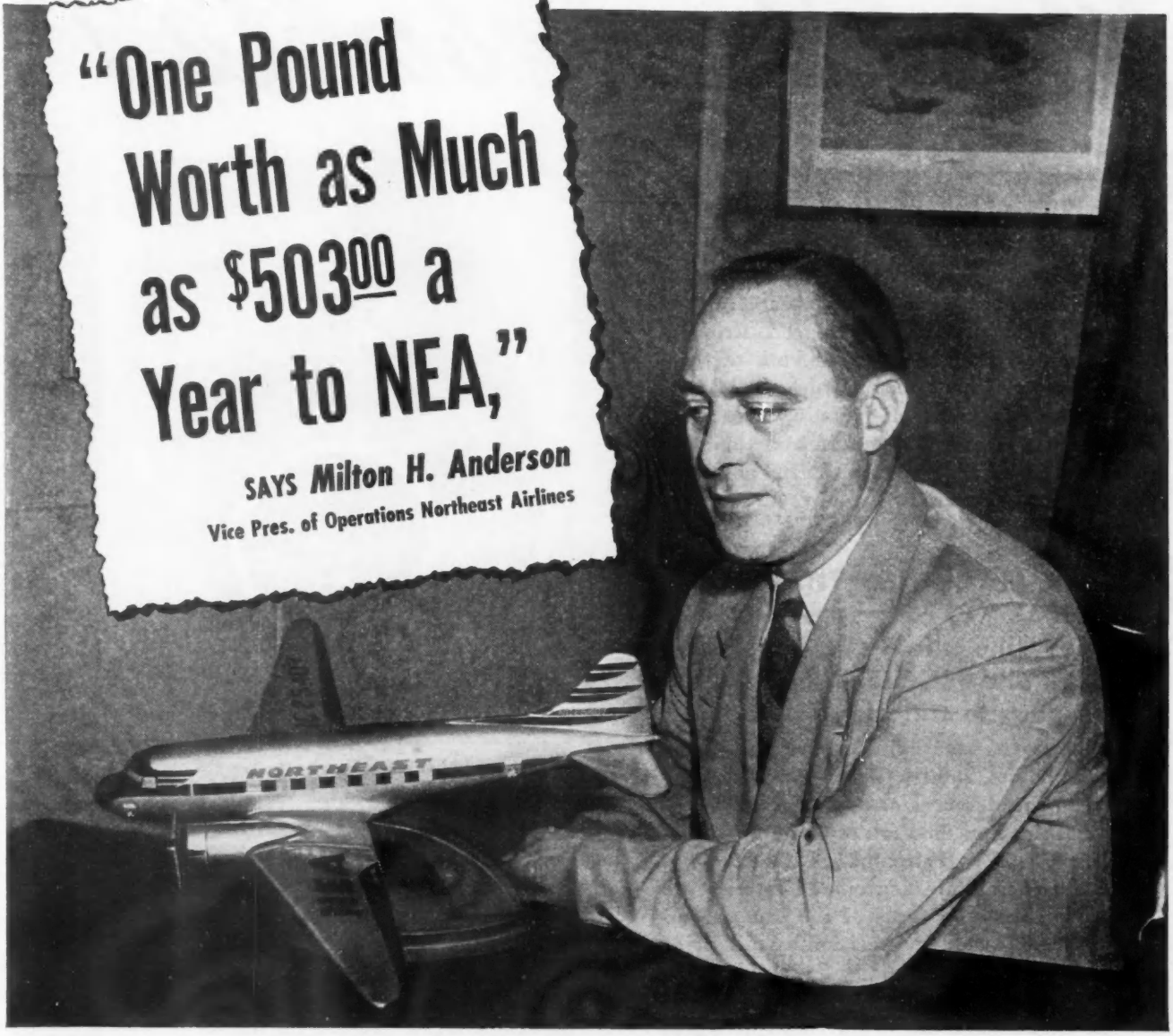


Cross Section of Ozalid Model B Illustrated Above. Designed for Large Scale Production. Other machines for lighter production or for use with blueprint equipment. Same *dry* principle, same advantages.

"One Pound Worth as Much as $503.00 a Year to NEA,"

SAYS **Milton H. Anderson**

Vice Pres. of Operations Northeast Airlines



"Our experience in New England over a period of years emphasizes the value of every pound of increased pay load. Each pound of unnecessary weight saved can mean that much more for passengers and cargo. For example, one pound of excess weight on the Boston-New York run, operated with 24-passenger DC-3's on hourly schedules, could cost Northeast as much as $503.00 a year."

Boots Nuts Save Up to 60 Lbs. Per Plane

- Lighter, tougher, Boots step up cargo capacity.
- Meet all specifications of government aviation agencies.
- Standard fastenings on all post-war commercial ships.
- Wartime standard nuts on all types of planes—fighters, bombers, transports.
- Can be used again and again—yet self-locking grip never slips.
- "Outlast the plane."

Motion Picture—"All Work And NoPlay"—16 mm. sound—30 minutes. Write for information.

BOOTS STEEL ANCHOR NUT

(W2S #8-32) The comparable fibre nut is 151.2% heavier than this all-metal, steel self-locking nut.

Send for Free Weight-Saving Booklet

Actual weights of over 250 different self-locking nuts used in aircraft, comprehensively reviewed for the convenience of aircraft designers, engineers, operating and maintenance personnel. Copy will be sent you, free, on request.

BOOTS SELF-LOCKING NUTS

"They Fly With Their Boots On—Lighter"

Boots Aircraft Nut Corporation, General Offices, New Canaan, Conn., Dept. H

Representatives in New York • Chicago • Detroit • Indianapolis • Los Angeles • Kansas City • Dallas • Toronto • Montreal • Vancouver

Indispensable!

1 THE "EYES" OF THE AIR — furnishing 90% of all military intelligence and reconnaissance data.

Not one square foot of strategic enemy territory escapes the aerial camera's searching, all-seeing eye. Fairchild Camera & Instrument Corporation manufactures the bulk of these vital cameras which must be ruggedly built to withstand all kinds of operating conditions such as extremes of temperature and humidity. Above all, they must be compact and *precision-made* to guarantee swift, clear, and utterly dependable results.

2 THE MACHINES THAT MAKE THESE "EYES" — precision machines like the P&W VERTICAL MILLER and PROFILER which shapes vital parts to critical tolerances.

Seating surfaces on film magazine base plates, camera bodies, and lens cones — which must be held to tolerances as close as ±.0003″ — are machined on the Pratt & Whitney Vertical Miller & Profiler (Fairchild has 10 of these in constant operation). If specified tolerances are not held here, the focus of the camera lens would be affected. On precision machining of the many irregular castings, Fairchild uses a double-spindle set-up on this machine.

In vitally important work like this where accuracy and dependability coupled with swift production and low cost are prime requisites, the P&W Vertical Miller & Profiler is proving itself "best for the job" 365 days a year. For full details, write Pratt & Whitney, *Division* Niles-Bement-Pond Company, West Hartford 1, Connecticut.

Putting the "Eye" on the enemy. Army photographer using the Fairchild K17 camera for oblique photography. This same unit is also used for mapping and reconnaissance photography. *U. S. Army Air Force Photo*

Accuracy in Action. For machining the body casting of a K18 camera, Fairchild uses a fly cutter operation on a P&W Vertical Miller and Profiler. This is the critical surface upon which the lens cone is attached and must be accurate.

PRATT & WHITNEY

Division Niles-Bement-Pond Company

WEST HARTFORD 1, CONNECTICUT

Deepfreeze Cascade −120° F. Industrial Chilling Machine designed for numerous high production cold treating operations.

GAUGE GROWTH ELIMINATED AFTER *Cold Treating* IN A Deepfreeze Industrial Chilling Machine

"H" type pin gauges completely stabilized by cold treating.

In Addition, Gauge Life Lengthened as a Result of Increased Metal Hardness

Here is a typical example of how manufacturers are using cold treating to stabilize gauges and other precision machine parts. Under conventional production methods the "H" type pin gauges shown above grew as much as .001" to .0015" while stored in tool cribs. Now, after cold treating, at −120° F. in a Deepfreeze Industrial Chilling Machine before final machining, the gauges hold their original dimensions for indefinite periods of time. In addition, the increased hardness of the metal obtained in the same cold treatment resulted in improved wearing quality of the gauges.

COLD TREATING FACTS

MACHINE—Deepfreeze — 120° F. Industrial Chilling Machine.

PART—"H" type pin gauges.

GAUGE SIZES—3.000 4.330, 5.000, 6.250, 7.000.

MATERIAL—S.A.E. 1095 Carbon Tool Steel for gauging blocks; cross piece from cold rolled bars.

TREATING PROCEDURE—(1) Heat to 1450° F.; (2) water quenched; (3) immersed in water approximately 210° F. for 1½ hours; (4) return to room temperature; (5) transfer to Deepfreeze at — 120° F. for 1½ hours; (6) return to room temperature; (7) given a draw of 375° F. for 1½ hours; (8) cooled to room temperature; (9) return to Deepfreeze for 1½ hours; (10) return to room temperature; (11) immersed in hot water at 210° F. for 1½ hours; (12) return to room temperature; (13) again cold treated in Deepfreeze at — 120° F. for 1½ hours; (14) return to room temperature; (15) finished ground to size.

NOTE: Every effort was made to make the rise and fall of the temperature continuous without any prolonged rest between the hot and cold point reached.

RESULTS: These gauges were checked for size immediately after cold treatment, then four months later, and once again two months later. It was found that growth was held to a maximum of .00004" as compared to the previous growth of .0015."

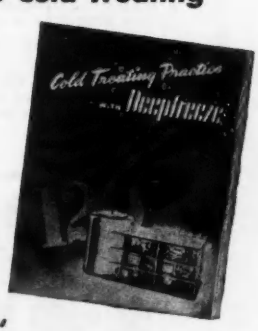
How Others Are Using Cold Treating

Cold treating is being practically applied at present by numerous manufacturers of diversified products for the following purposes:

Treating of high-speed steel cutting tools.
Shrinking of metal.
Shrink-fit assembly.
Stabilization of gauges.
Hardening precision machine parts.
Testing of aircraft instruments and materials.
Testing of lubricants, paints, plastics, chemicals, synthetic rubber and pharmaceuticals.

FREE *Complete, Up-to-date Cold Treating Information...*

Our new 40-page booklet covers every phase of cold treating from its inception to the present time. It gives specific information on how such manufacturers as Curtiss-Wright Corporation, Cincinnati Milling Machine Company, Ford Motor Company, Savage Tool Company, Kearney & Trecker Corporation, and many other Deepfreeze users are applying cold treating to their production. Write today for Bulletin No. 1-4.



Only Motor Products can make a "DEEPFREEZE"

Deepfreeze

2314 DAVIS STREET
NORTH CHICAGO, ILLINOIS

TRADE MARK DEEPFREEZE REGISTERED UNITED STATES PATENT OFFICE

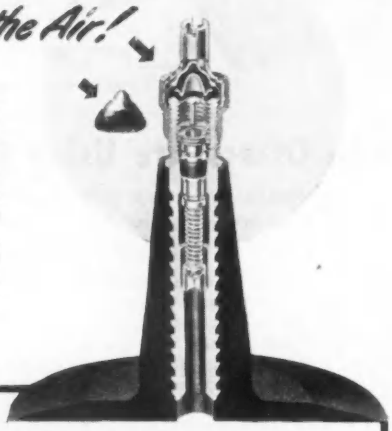
Industrial Chilling Equipment for Shrinking, Testing, Hardening and Stabilizing Metals

Division of Motor Products Corporation, Detroit, Michigan

OR- THIS?

This Seals the Air!

All Standard Schrader Valve Caps in use today contain the specially designed sealing unit with a dome-shaped rubber washer vulcanized between two dome-shaped BRASS plates. Because of their unique construction, these caps are guaranteed airtight up to 250 lbs. pressure. This mighty midget does the work.



MR. & MRS. AMERICA

How to help save your tires. Make it a habit to:

1. Check the tightness of your valve cap each time after you inflate your tires to effect a 100% seal.
2. While you have the cap off (to gauge or add air) look inside it to see if the washer is worn out.
3. If you have no cap or the washer is worn out, replace it as soon as possible with a Standard Cap to be sure that underinflation cannot be caused by leakage through the valve.

Schrader
CONTROLS THE AIR

Would you use an elephant if your tires wore out? Of course not—but one might be handy if you couldn't get the new tires you need. With 150,000 cars going off the road every month, many because of worn out tires, you had better "baby" your present tires, if you want to continue driving.

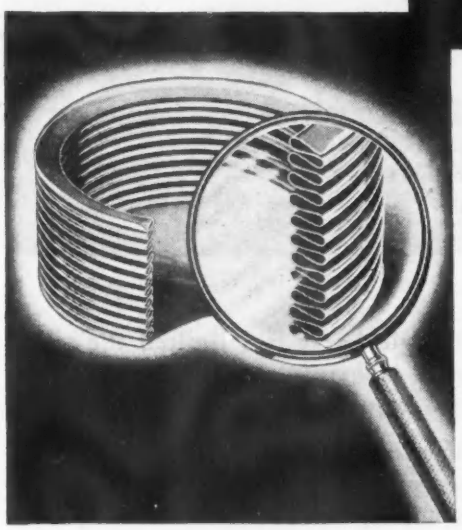
The most important single factor in preserving tires is proper inflation, for lack of even a few pounds causes excessive wear, damage to side walls and less mileage. How to prevent ruinous underinflation? It's easy. (1) Check air pressures regularly with an accurate gauge. (2) Inflate when needed. (3) Seal the air in at the valve mouth with an airtight Standard Schrader Valve Cap.

Our Armed Forces know the importance of Standard Caps. No pneumatic-tired vehicle passes inspection unless a Standard Cap is screwed down tight on the tire valve mouth. And since their need is greater than ours, your dealer may be temporarily out of caps. Try again later—and be sure a Schrader Cap is on every tire, including your spare, as soon as possible.

ORIGINATORS OF THE COMPARATIVE AIR LOSS SYSTEM

CAPS are vital for TIRE CONSERVATION

A. SCHRADER'S SON, *Division of Scovill Manufacturing Company, Incorporated,* BROOKLYN, NEW YORK



NOTE UNIT CONSTRUCTION. **Bellows is a one-piece expansible and collapsible member. Side-walls are deeply folded or corrugated as pictured above. No seams or solder.**

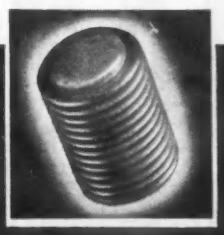
TIRELESS WORKER!

HOUR AFTER HOUR . . . day in, day out . . . a bellows proves a tireless worker *if it fits the job.*

Actually, there's only one best type and size for a particular application . . . the bellows that is engineered to meet all conditions encountered in actual usage.

That is why much care should be taken when selecting a bellows . . . why our engineers insist upon exact data covering every phase of the working conditions under which each bellows is to operate. With these facts at hand they can assure the dependable performance for which Bridgeport Bellows are famous.

Why not consult Bridgeport now regarding your present or post-war bellows requirements? Catalog YB-100, full of valuable information, will be sent upon request.



Bellows Assemblies . . . Bellows . . . Bellows Devices

SHOCK!
STEEL
STEEL
METAL-TO-METAL contacts cause SHOCK . . VIBRATION . . NOISE . . WEAR . . DESTRUCTION!
RUBBER
RUBBER
RUBBER-TO-RUBBER contacts ABSORB shock . . . MINIMIZE vibration . . . MUFFLE noise . . . PROLONG LIFE of moving parts!
Cut-away view of threshing mechanism in a modern combine. Rubber faced steel cylinder bars, operating in connection with a rubber stripping plate, and two stationary block rubber concaves, protect hard and soft shell crops from damage.

SHOCK is the foe of machinery. SHOCK and resultant VIBRATION caused by metal-to-metal contacts of moving parts are fast being eliminated by modern processes of rubber-to-metal adhesion.

A "striking example" of metal-to-metal *versus* rubber-to-rubber contacts is the development of the modern combine or "all-crop harvester."

ORCO engineers, working closely with farm machinery engineers, applied modern rubber adhesion processes to eliminate metal-to-metal contacts in threshing mechanisms.

The "end result" was elimination of SHOCK which in old style harvesters limited the machines to hard shell crops and often caused damage to both crops and machines.

Rubber-to-rubber contacts now widen the scope of the modern combine to include soft shell as well as hard shell crops. Machines last longer. Crops are protected against crushing. Operators are relieved of fatigue caused by excessive noise and vibration.

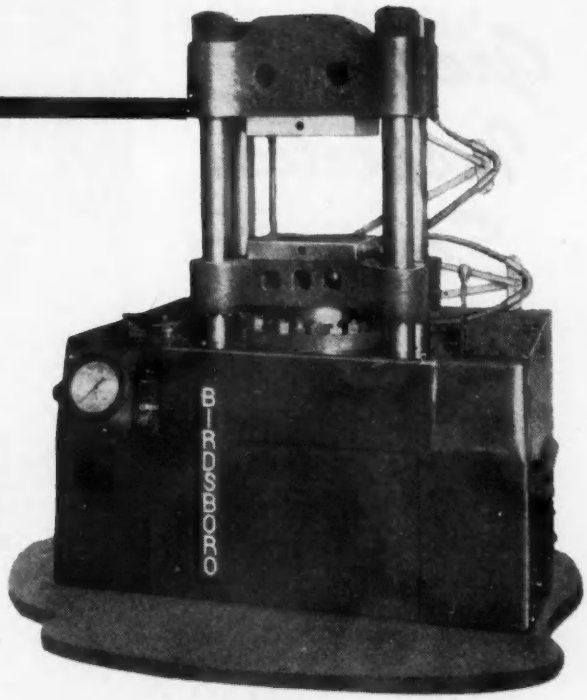
When YOU encounter problems involving SHOCK and VIBRATION in moving parts of machinery, ORCO engineers are prepared to co-operate. Ask for ORCO-OPERATION!

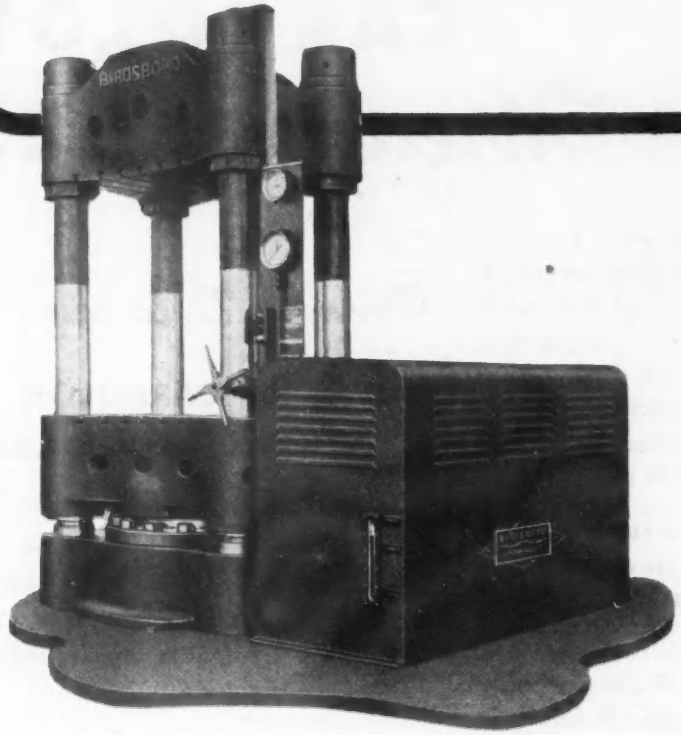
"ORCO-OPERATION"

THE OHIO RUBBER COMPANY · WILLOUGHBY, OHIO

BRANCHES: DETROIT · NEW YORK · CHICAGO · INDIANAPOLIS · WASHINGTON · CLEVELAND

IMMEDIATE PRODUCTION ... *with* SELF-POWERED PRESSES





These BIRDSBORO Self-Powered Plastic (Compression) Molding Presses are equipped with built-in Hydraulic systems complete with pumps and controls capable of producing required variable pressures and rates of speeds. This means that plants without existing accumulator facilities can rapidly get into production with these Birdsboro Plastic Compression Molding Presses.

Our specialty is designing and building hydraulic presses to meet the needs of the plastic industry. Take advantage of Birdsboro's long press-making experience to secure the presses you will need to meet competition.

BUY WAR BONDS

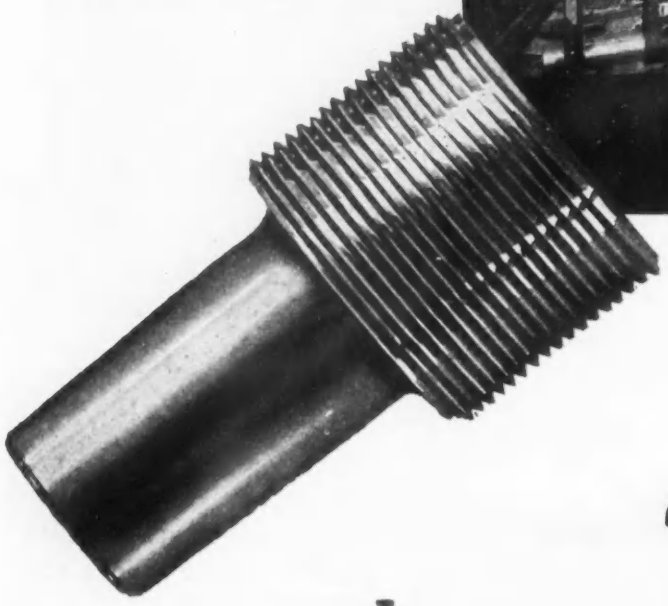
BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY • BIRDSBORO, PENNSYLVANIA

BIRDSBORO

HYDRAULIC PLASTIC PRESSES

Greater Inspection Economies ARE YOURS

A section of the Lincoln Park thread grinding department, showing a portion of the modern equipment which is in constant use.



THROUGH THE USE OF CARBOLOY *Thread* GAGES

LINCOLN PARK was the first company to successfully produce Carboloy thread gages. It is the result of the pioneering work done and the wide experience gained over many years in manufacturing gages of this wear-resistant material that Lincoln Park thread plug gages are today providing exceptional inspection service. Records show that on many jobs more than 1,000,000 threaded holes have been inspected with one of these gages.

Lincoln Park Carboloy thread plug gages are supplied in a standard size range from a No. 4 machine screw size to 3" diameter to meet almost any specifications for tolerance, lead or pitch.

It will pay you to learn fully how Lincoln Park Carboloy thread plug gages can be used profitably and efficiently in your inspection operations.

Prompt Delivery

OF CARBOLOY THREAD PLUG GAGES

Our weekly "Current Delivery Schedule" will keep you informed on deliveries of Lincoln Park products. Write us and we will see that a copy is mailed you regularly.

LINCOLN PARK INDUSTRIES, INC.

Successor to The Lincoln Park Tool and Gage Company and Carbur, Inc.

1727 FERRIS AVENUE • LINCOLN PARK 25, MICHIGAN

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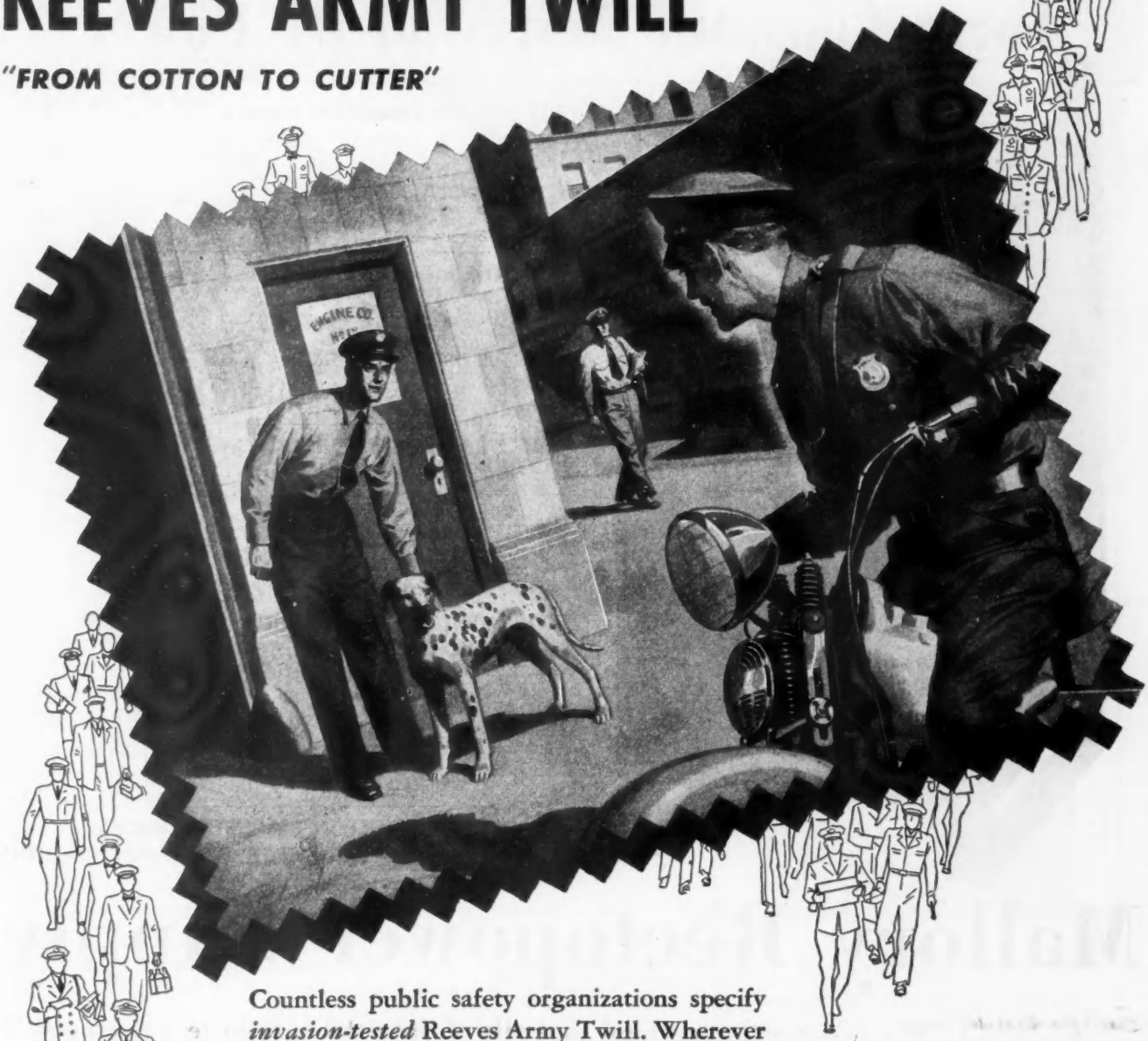
FOR PROTECTION AGAINST WEAR AND TEAR—*DEMAND*

REEVES ARMY TWILL

"FROM COTTON TO CUTTER"



Countless public safety organizations specify *invasion-tested* Reeves Army Twill. Wherever durable, good-looking uniforms are needed, this top-quality fabric tailors smartly and gives superb service. Over 80 million yards of it have already been used to help equip America's fighting men, and it is proving itself under the toughest climatic and combat conditions of global war. This fabric, Sanforized Shrunk* and color-fast to sun, water and perspiration, will meet *your* post-war uniform needs. When the time comes to order them, choose from a wide range of popular colors, for long-lasting good looks insist on Reeves Army Twill.

**Residual shrinkage less than 1%*

THE REEVES FABRIC GROUP INCLUDES: *Reeves Army Twill • Glengarrie Poplin • Reeveking Gabardine • Byrd Cloth • Marine Herringbone • Mountain Cloth • Warrior Twill*

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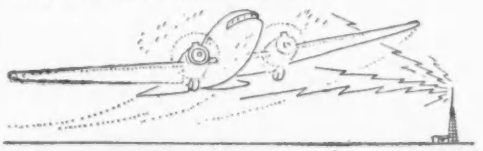
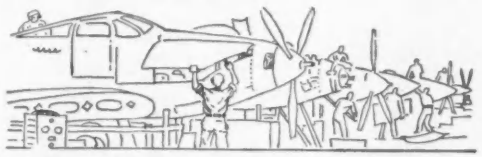
All-Purpose Rectifier For a Constant Source of DC Power

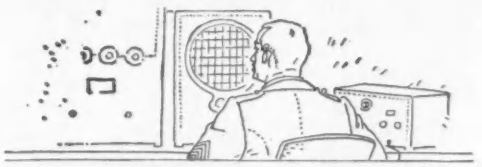
FOR AIRLINE COMMUNICATIONS



AIRPLANE MANUFACTURERS



POLICE RADIO COMMUNICATIONS



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FOR INDUSTRIAL USE IN MAGNETIC CHUCKS, SORTING METALS, AND ELECTROLYTIC APPLICATIONS

Mallory Rectopower Supply

Units for 115 volt single phase AC with outputs of 6, 12, 24 and 32 volts DC current at 10 or 25 amperes.

Units for 230 volt 3 phase AC with outputs of 12, 24 and 32 volts DC current at 50 amperes.

ARMY E NAVY

If you can't invade, invest!
—Buy War Bonds

Compact size and ease of installation make this Rectopower an ideal DC power supply for every application. It furnishes DC current by means of "Time-Tried and Proven" Mallory magnesium copper sulphide dry disc rectifiers. And *that* means longer life, greater operating efficiency, because of the absence of moving parts. For DC power supplies that entail no worries about current variations or power failures, see your Mallory distributor, or write direct.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

*Rectostarter is the registered trademark of P. R. Mallory & Co., Inc., for rectifier units for use in starting internal combustion engines.

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MALLORY

MAGNESIUM COPPER SULPHIDE RECTIFIERS—
STATIONARY AND PORTABLE D. C. POWER SUPPLIES—
BATTERY CHARGERS AND AVIATION RECTOSTARTERS*

IF YOU HAD AN X-RAY EYE YOU'D SEE WHY RESISTOFLEX HOSE* IS DIFFERENT

No hose can be more efficient than its tube. And if you were able to see through a Resistoflex hose that had been used for years, you would see the compar tube, unchanged since its original installation.

For compar is an elastomer that varies in formulation according to the job it is to do. Compar is completely immune to the corrosive and erosive attacks of gasoline, fuel oils, organic solvents, hydraulic fluids and lubricants. That is why compar *cannot* shrink in diameter... neither can it swell, rot, nor slough-off.

You would also see a tough reinforcement of selected fabric or fine wire spun around the compar tube. Thus, pressure resistance is built up without loss of flexibility.

And for even greater strength, a rugged outer cover of special formulation protects the hose assembly from external abrasion and rough handling as well as the corrosive effects of oil and moisture.

Yes, if you had an X-ray eye you would see compar, reinforcement and outer cover; and you would readily understand why Resistoflex hose has *never failed due to vibration or flex under normal operating temperatures.*

• • •

A staff of engineers, maintained by the Resistoflex Corporation, is prepared and willing to help you with your flexible hose problems. Laboratory technicians will be glad to work out special purpose formulations of compar for you, should your problem require them. A short letter will bring you the benefits of their experience without obligation.

***THE TUBE IS THE HEART OF THE HOSE— INSIST UPON IT BEING COMPAR**

NO EROSION OF FUEL LINES HERE

Lorain Diesel-powered shovels, manufactured by The Thew Shovel Company, perform some of the world's toughest digging jobs.

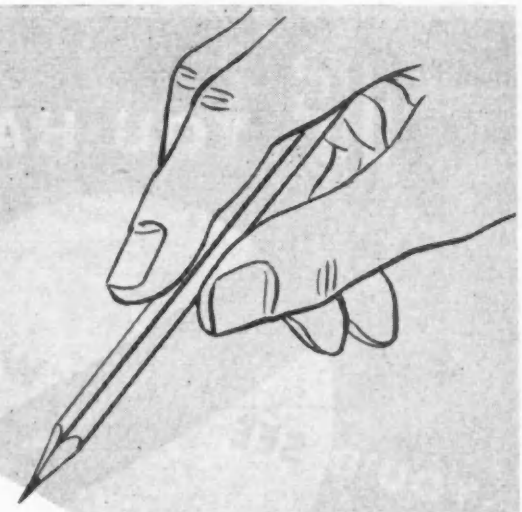
To safeguard against fuel line failure, Resistoflex flexible hose assemblies are standard equipment on *all* Diesel engines in *all* Lorain shovels.

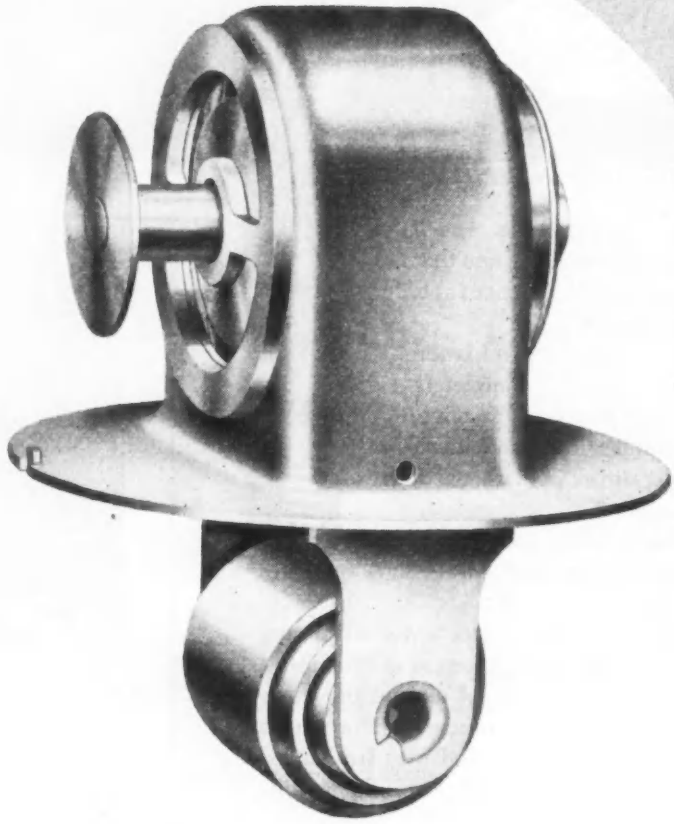
Resistoflex lines with the compar tube are absolutely impervious to attack by Diesel fuels, vibration or flexing. There is no gumming, no tendency to choke the fuel flow, no aging, oxidation or collection of foreign solids. That's why Diesels the world over are equipped with flexible Resistoflex hose assemblies.

RESISTOFLEX

RESISTOFLEX CORPORATION, BELLEVILLE 9, N. J.

BEFORE THE FINAL SPECIFICATIONS ARE WRITTEN . . .





DOLE Thermostats

The seriousness of the job justifies looking into every possible improvement before the new car designs are crystalized. When it comes to thermostats for motor temperature control, the advantage of a wise choice will show up in all 'round better performance—quick warm-up—reduction of crank case dilution—savings of gasoline, oil and the motor.

THE DOLE VALVE COMPANY
1901-41 Carroll Ave., Chicago 21, Illinois
LOS ANGELES • DETROIT • PHILADELPHIA

Announcing

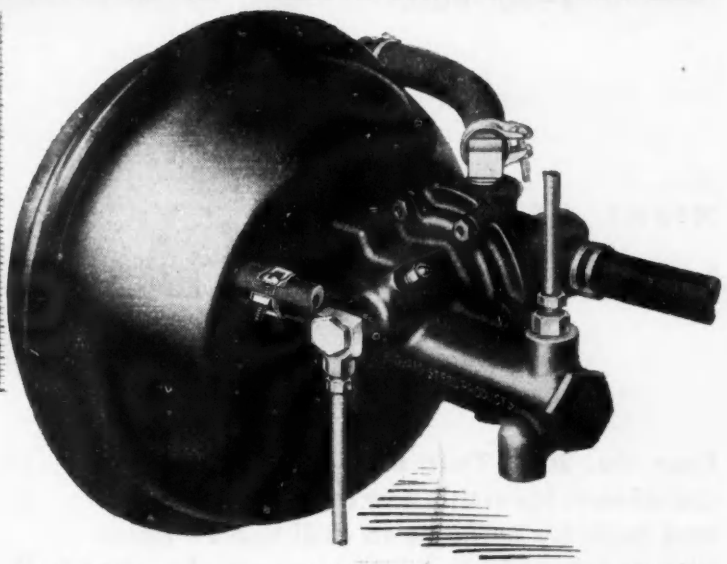
HY-POWER

the newest development in

POWER BRAKES

HY-POWER

THE MIDLAND STEEL PRODUCTS CO.
CLEVELAND, O. • DETROIT, MICH.
PATENTS PENDING



HY-POWER *Gives You Many Advantages . . .*

No lubrication

Simple in design, rugged in construction.

Reduces physical effort and gains added power.

No braking forces are applied to mounting brackets.

Simple to install. Can be located any available place on chassis.

Does not interfere with operation of the standard hydraulic system.

Complete in one assembly. No adjustments necessary when installing or during service. No units to align.

Sealed system. All moving parts completely enclosed. Protected from all atmospheric conditions. No mud, water, dust, dirt, rust or corrosion.

THREE time-tested features of Midland Power Brakes are combined in a single device in Midland's sensational new HY-POWER unit: vacuum diaphragm chamber—hydraulic vacuum valve—hydraulic slave cylinder. HY-POWER is a completely enclosed and simplified device providing surer, safer braking. HY-POWER is compact—easy to install—sealed against all weather and atmospheric conditions—offers direct applied power—less weight—no lubrication—long life. Write, wire or phone for detailed information, specifications and illustrated, descriptive folder.

THE MIDLAND STEEL PRODUCTS CO.

10603 MADISON AVE. • CLEVELAND 1, OHIO

Export Department: 38 Pearl Street, New York City

MIDLAND POWER BRAKES

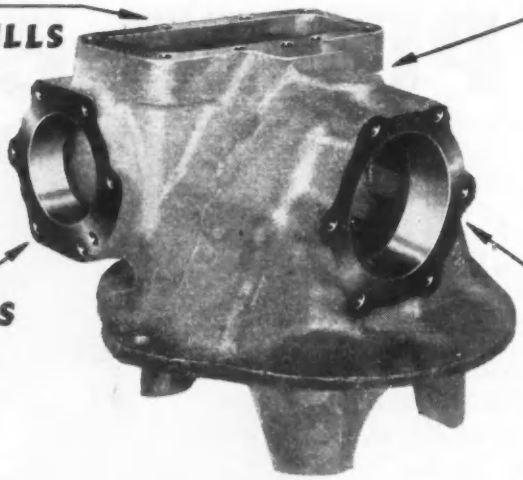
ANOTHER APPLICATION OF THE LEMAIRE TWIN RAM HYDRAULIC UNIT

29 HOLES DRILLED FROM 4 DIRECTIONS

IN A TRUCK AXLE MOUNTING

VERTICAL HEAD DRILLS
8–5/16" HOLES
1–27/64" HOLE

LEFT HEAD DRILLS
6–27/64" HOLES
1–1/2" HOLE



RIGHT HEAD DRILLS
6–27/64" HOLES
1–1/2" HOLE

REAR HEAD DRILLS
5–27/64" HOLES
1–31/64" HOLE

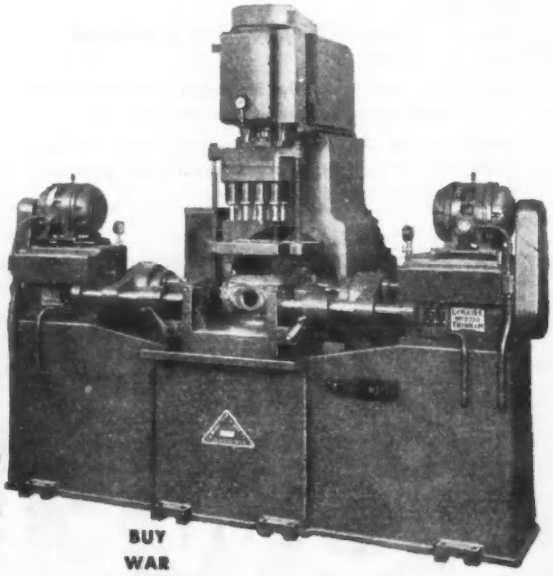
Four No. 2000 Twin Ram Hydraulic Units combine to form this new machine designed and built by LeMaire to drill the 29 holes in a truck axle mounting or carrier. At each end of a fabricated main base facing each other are two Units. Bolted to an auxiliary base at the rear is a third unit, while a "straddle column" supports a fourth over the center of operations. The first three drill horizontally while the latter drills vertically.

Recorded production is shown at approximately 45 pieces an hour.

(A machine similar to this is used for tapping. It will be described next month.)

This is another instance that demonstrates the versatility of LeMaire Twin Ram Units.

Does this suggest a possible application in your production routine—either now or for your future plans? We invite you to discuss these matters with our engineers.



LEMAIRE PRODUCTS

LeMaire

BUILDERS OF
SINGLE AND MULTIPLE SPINDLE MACHINES
FOR BORING, DRILLING, REAMING,
TAPPING, ETC.—TWIN RAM HYDRAULIC
UNITS—MATCH-IT GEAR CHUCKS

LEMAIRE TOOL & MFG. CO.
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"MICROMETER CONSCIOUS"

in the quantity production of minute precision parts

Forty-five manufacturers of major prominence now are relying upon the micrometer-conscious Wadsworth Small Parts Division for scores of parts so minute and precise that their quantity production is difficult or expensive for the average plant.

At Wadsworth, such production is customary, and meets the highest critical standards.

Here, a unique machine setup and workers who *think* precision are intimately associated under one roof. They contribute special operations to many pieces and carry others through in their entirety, in great quantities.

We welcome conversations with all companies who intend to be postwar factors in their fields and will be glad to discuss the matter of applying Wadsworth skills to your special needs.

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SMALL PARTS DIVISION

THE *Wadsworth* WATCH CASE CO., Inc.

DAYTON, KENTUCKY, SUBURB OF CINCINNATI, OHIO

PHONE COLONIAL 8194 • (CINCINNATI EXCHANGE)

Wadsworth is heavily engaged in many-sided war work. But our steady production of Military Watch Cases and our constant designing of the precious metal cases for the future are preserving the art of fine watch case development.

Upsetting gets work under way fast

In two quick steps, this little part is made. The head and the shank with projection are upset from Alcoa Aluminum wire in a rivet header. A blanking operation shapes the head, and the part is ready for heat treating.

Dimensions can be closely controlled in these heading and blanking operations. Parts, like the carriage bolts you see in the photograph, can be produced with well filled-out square shoulders without the need of expensive milling operations.

Where design and quantities warrant production by upsetting, this process develops sizable economies. In addition to being fast, it saves raw material. You use all the metal you start with, obtaining final shapes by upsetting.

Alcoa is equipped to supply you with aluminum parts produced either on rivet headers, on automatic screw machines or a combination of both. Recommendations are based, therefore, on the most economical method. ALUMINUM COMPANY OF AMERICA, 2110 Gulf Bldg., Pittsburgh 19, Pennsylvania.

ALCOA ALCOA ALUMINUM REG. U. S. PAT. OFF. **ALUMINUM**

(*Advertisement*)

Conversion Job... from BORING to MILLING

and at a substantial saving in machine cost

This Snyder two-way machine originally was designed and built for a medium boring operation on an ordnance part. When that particular contract was completed, the machine was turned over to Snyder for conversion to a milling operation on another ordnance part.

The conversion process utilized most of the original machine including base and units. Two single-spindle heads were mounted on each end, these being hydraulically operated and electrically controlled by push button.

Besides the considerable saving in time, there accrued also a saving of approximately 50% as compared to the cost of a new machine.

Many machines now operating on war contracts are similarly convertible and offer comparable opportunities for savings in time and money. The time-saving feature will be particularly important when the objective is to reach markets with civilian goods as quickly as possible.

Anticipating the day when war contract machines will become available for conversion to peacetime production, we suggest that you get in touch with us now with the idea of discussing your machine conversion problems and objectives and—as a farsighted precaution—possibly making a reservation for the engineering and plant facilities which will be required for your conversion work.

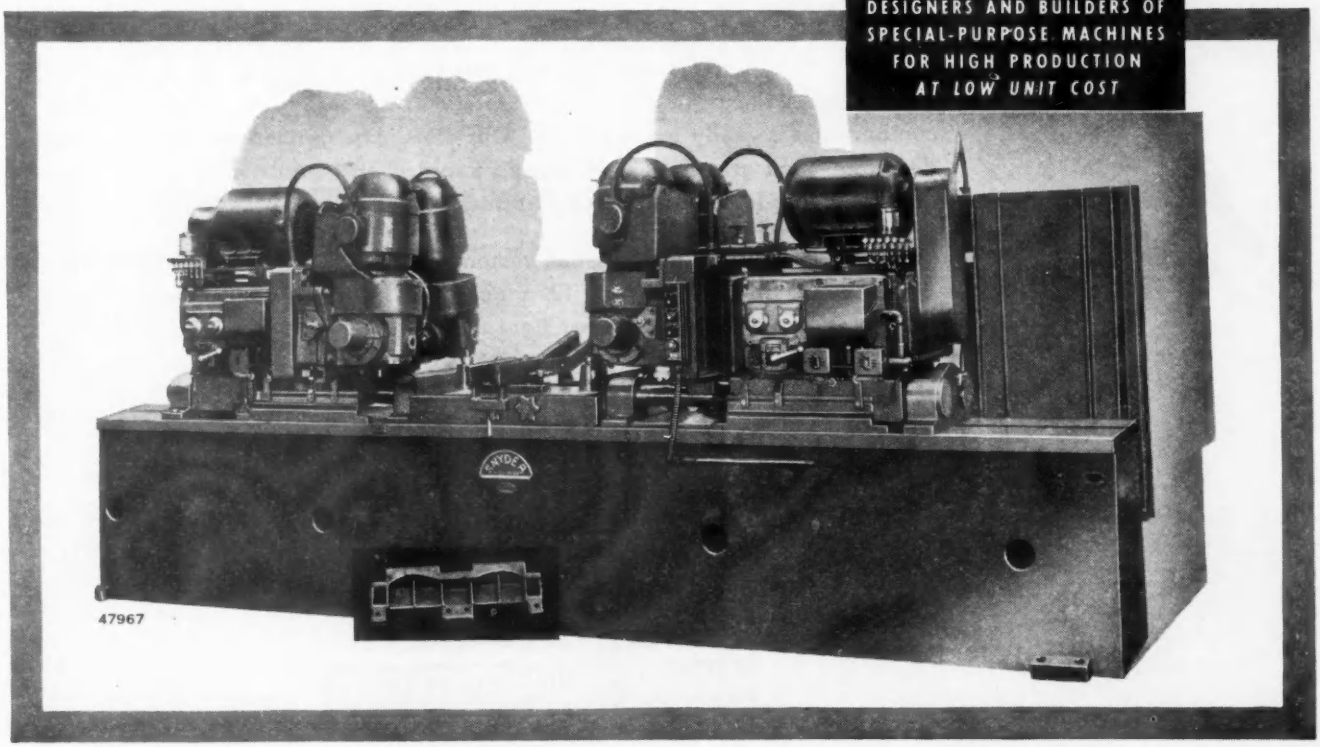
We invite you to write us in full confidence. *Snyder Tool & Engineering Company, 3400 E. Lafayette Ave., Detroit 7, Mich.*

PLAN Your PRODUCTION when you PLAN Your PRODUCT

20 Years of Successful Co-operation with Leading American Industries

SNYDER

DESIGNERS AND BUILDERS OF SPECIAL-PURPOSE MACHINES FOR HIGH PRODUCTION AT LOW UNIT COST



PLASTIC injection molded. Industrial application. Injection up to 18 oz. per shot.

METAL STAMPINGS. Formed. Curled and assembled.

Complete service

PLASTIC MOLDING
METAL STAMPING
PLASTIC *with* METAL

America's largest industries are benefiting by our experience in both Plastic Molding and Metal Fabricating. This unique service combination is ready to serve you. Our alert, experienced engineering and designing staff are abreast of today's rapid changes in materials and production methods, for both Metal Fabricating and Plastic Molding.

Our PLASTIC DIVISION furnishes custom molding in all thermoplastics from a fraction of an ounce up to 18 ounces per shot. Our METAL DIVISION fabricates in all heavy and new light metals. Drawing, Coining, Stamping, Welding, Rolling, Forming.

THE METAL SPECIALTY CO

PLASTIC MOLDING
METAL STAMPING

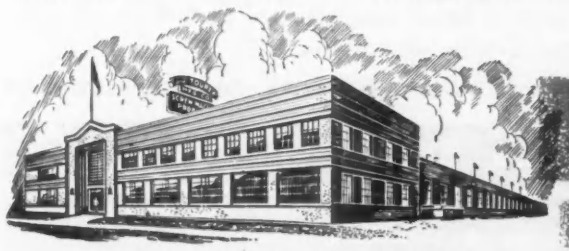
ESTE AVE. • CINCINNATI 32 • OHIO

BRANCH PLANT — SOUTH L ST., RICHMOND, IND.
SALES OFFICE — W. GRAND BLVD., DETROIT, MICH.

BATTERIES OF *Big Ones* WORK FOR YOU AT TOUREK!

To put production of your screw machine products on a real volume basis, Tourek is fully equipped with the "big ones"—four- and six-spindle automatics of latest design. These and smaller automatics, together with all necessary machines for secondary operations, backed up by outstanding tool room and engineering facilities, enable Tourek to produce your parts in any quantity . . . in any type of metal . . . and in any size up to 2⅝ inches. Put Tourek's engineering ingenuity, top notch equipment, and successful experience of nearly a quarter century to work for you!

J. J. TOUREK MFG. CO.
4701 W. 16TH STREET CHICAGO 50, ILLINOIS



MAKERS OF THE FAMOUS TOUREK BALL JOINTS

ESTABLISHED 1920

TOUREK

PRECISION SCREW MACHINE PRODUCTS

A plain plug or ring gage, worthy of the name, must have a hard, durable surface, mirror finish and a uniformly smooth face that can withstand the microscopic scrutiny of the surface analyzer.

Achieving this perfection is not easy. Grinding the plug or ring down to the right amount of lap stock requires that intangible quality known in shop parlance as "feel". Lapping the minute grind ridges down to an even, durable surface and, at the same time, holding the dimension within tolerance, is another example of "feel".

Highly skilled craftsmanship plus a constantly controlled precision inspection—that is the Vinco formula for producing a perfect cylindrical gage.

Don't let the simplicity of cylindrical design swerve better judgment. A perfect cylindrical gage is a sound investment. To insure that investment, buy Vinco.

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MILLIONTHS OF AN INCH FOR SALE BY VINCO

Semi-Automatic Hydraulic Spline and Gear Grinder • Optical Master Inspection Dividing Head • Involute Checker • Angle Tangent to Radius Dresser • Index Plates • Precision Vises • Sine Bars • Straight-side Spline, Serration Spline, Involute Spline and Helical Spline Plug and Ring Gages • Thread Plugs, Rings and Setting Plug Gages • Spur and Helical Master Gears • Munition Gages • Propeller Hub Gages • Built-up and Special Gages • Gear Rolling Fixtures • Spline and Index Fixtures • Hydraulic Power, Control, Utilization and Distribution Units • Engineering, Design and Development.

FOR TOP-FLIGHT PERFORMANCE

90%

of all

Aircraft carburetors

built

are made by **STROMBERG**

Those who are intimately acquainted with the aircraft industry know that year-after-year acceptance of a product does not come by chance or luck. The accepted product holds its place on merit alone.

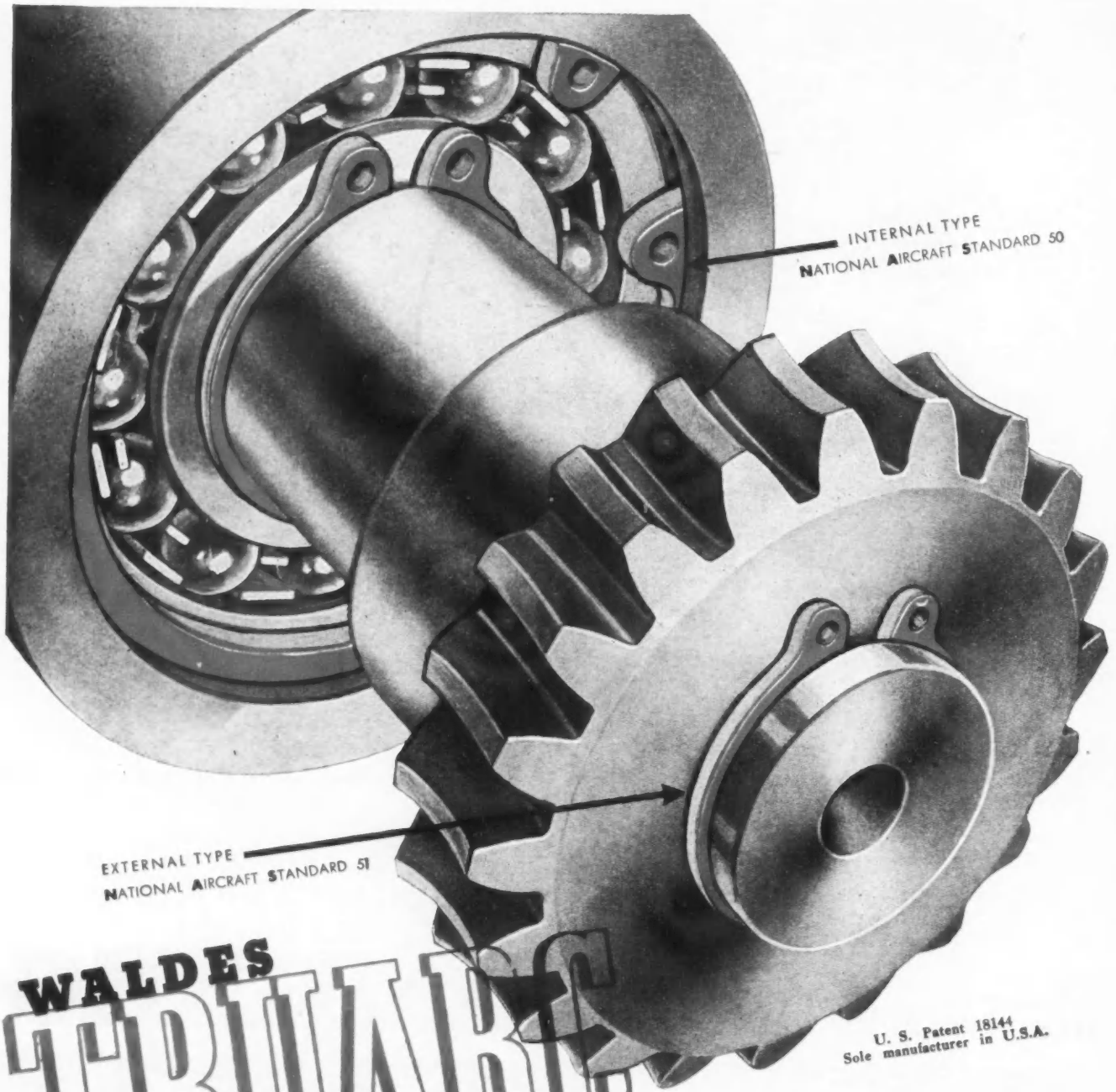
Nor does success in one year guarantee success in the next. The vigilant eyes of the industry keep constant watch. The inferior product is dropped as quickly as its shortcomings are discovered. The good product yields its place to the better. In this ceaseless struggle for survival, only the best remains in use.

There is, then, in these inflexible statistics, a story of product excellence far beyond the power of mere words to describe:

For the past ten years, the aircraft industry has preferred Stromberg to all others by 8 to 1. 90% of all Aircraft Carburetors built are made by Stromberg.

Bendix PRODUCTS DIVISION

Bendix Aviation Corporation, South Bend 20, Indiana



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U. S. Patent 18144
Sole manufacturer in U.S.A.

Waldes Truarc presents a significant advance in retaining rings.

This improved retaining ring spreads or contracts without distortion; always retaining its perfectly fitting circular contour.

For thrust load fixing, and shaft and housing applications, Waldes Truarc offers distinct space-saving and material-saving advantages over nuts and bolts . . . plus a stability and dependability heretofore not obtainable in retaining rings.

On request, we will gladly furnish samples and full data for your tests.

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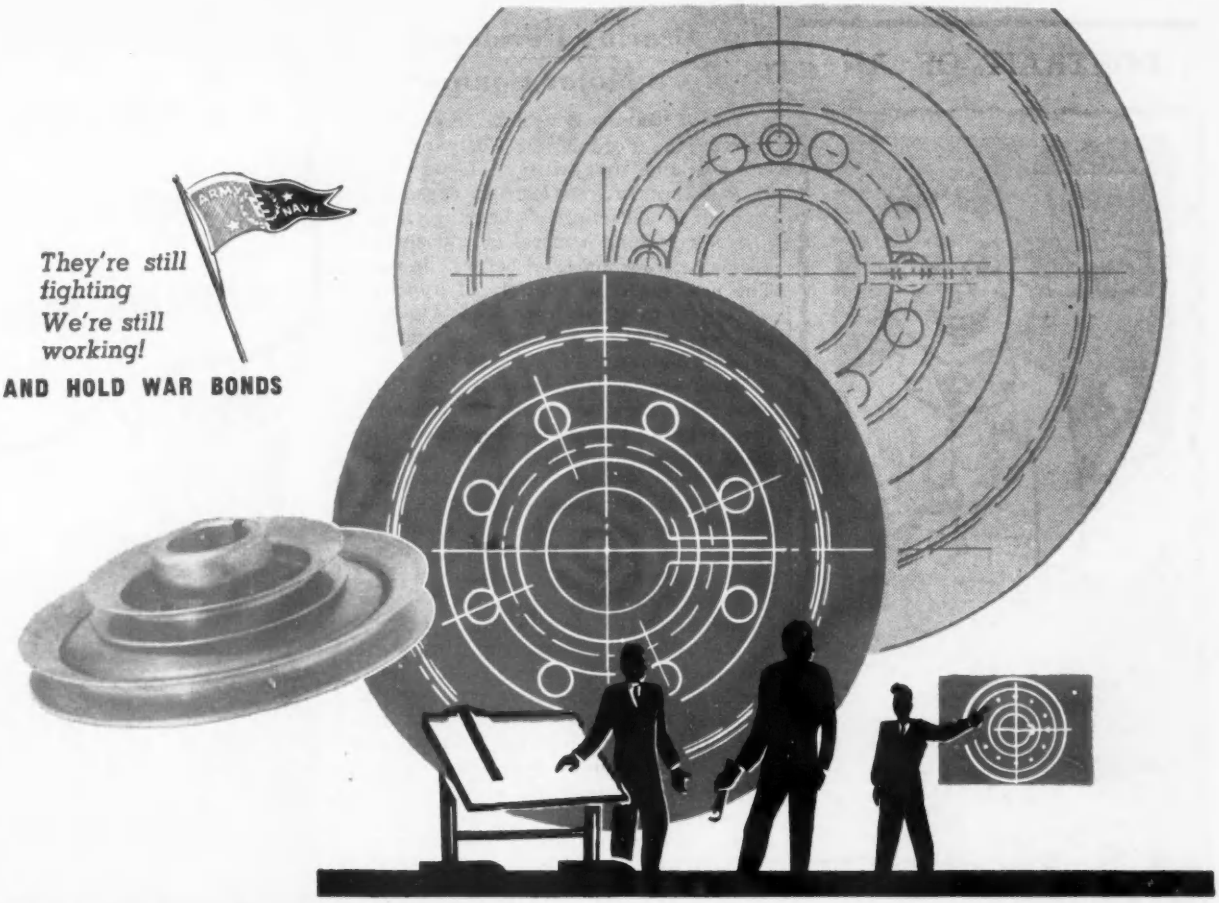

They're still fighting
We're still working!

BUY AND HOLD WAR BONDS

OUR ENGINEERS TALK in CIRCLES ... and it MAKES SENSE!

In discussing custom design of Spunsteel roller-formed pulleys you have to talk in circles—O.D.'s, I.D.'s, P.D.'s, and R.P.M.'s. And regardless of how complex each individual problem of application may be, its ultimate solution must make sense. The V-type pulleys you will need, for instance, may require but a single belt groove or they may require two, three or even four grooves—with all diameters identical or each diameter different. No matter what your pulley problem is, Spunsteel engineers would welcome the opportunity to assist in its solution. Eighteen years of specialized experience is your assurance that Spunsteel pulleys will be properly designed and properly fabricated to fully meet your specific needs and to provide for utmost economy in mass production. The patented Spunsteel automatic roller-forming lathes consistently turn out perfectly balanced, light weight, steel-strong pulleys for drive and driven installations. Consult Spunsteel on your pulley problems, and remember too, our extensive facilities for stamping, brazing, welding, assembling and finishing of other metal parts. Spunsteel Metal Engineering has a way with steel, doing things you might never have dreamed possible!

NOW MAILING

Six pages of pictures and facts on Spun Steel Metal Engineering will help you in organizing postwar production. This dependable source for metal parts offers the full co-operation of its creative engineering personnel for discussion of your problems now. Especially interesting: redesign of forged and machined bar stock parts for precision fabrication from stampings. Write today.

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SPUNSTEEL

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PORTRAIT OF AN

who says that even the newcomers can mate units more quickly when they assemble SCREW MACHINE PRODUCTS made FASTER and BETTER for LESS by

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CORPORATION
Screw Machine Products
AMHERST • OHIO

Chicago Detroit New York

New Bearing Developed By Ford Motor Company

A new bearing developed during the war by the Ford Motor Company will be available to owners of post-war Ford, Mercury and Lincoln cars. Described as a "tri-alloy" bearing, it replaces cadmium, a metal in widespread use as bearing material before the war. The new material consists of approximately 35 to 40 per cent lead, 4½ to 5 per cent silver, 5 per cent iron and the balance copper.

Tests are said to indicate that "tri-alloy" bearings last three times longer than regular bearings—even under the most trying conditions. When used on heavy-duty trucks operated between the Willow Run bomber plant and the Southwest, they showed a marked resistance to wear. In fact, some bearings and crankshaft journals disclosed no measurable wear after more than 50,000 miles.

"Tri-alloy" bearings were developed because of the weakness of ordinary bearings under the high stresses imposed by military operations. Cadmium and other metals, it was found, fatigued under these severe conditions for, unlike automobiles, which operate most of the time at comparatively low loads, military vehicles function at peak performance for many successive hours.

At the request of Army Ordnance, Ford began experiments in November, 1943, to find a bearing material that could withstand high loads for long periods. Test "coupons" of various sil-

(*Turn to page* 184, *please*)

Classified Advertisements

WANTED TRUCK BODY DRAFTSMEN Eastern Truck Manufacturer wants truck cab and body draftsmen, both detail and layout, experienced in full size cab and sheet metal design. Offer permanent connection for post-war. W.M.C. regulations apply. Include background and experience record in reply. Address reply to Box #19, Chilton Company, Chestnut & 56th Sts., Philadelphia 39, Pa.

IF YOUR POST-WAR PRODUCTS REQUIRE PRECISION UNITS our experience machining parts and assemblying aircraft units may be useful to you. We are now in position to undertake a limited amount of development work in anticipation of post-war production. We invite your inquiries. BRUENING-WINANS CORP'N, P. O. Box 935, Rochester 3, New York.

FOR SALE OR LICENSE—PATENTED OUTSTANDING HYDRAULIC DEVELOPMENT — Variable Displacement Pumps, Motors, and Hydraulic Transmissions, for industrial, aircraft, automotive, and miscellaneous pressure power applications. THE BEST ON THE MARKET. Write Box 22, Chilton Company, Chestnut & 56th Streets, Philadelphia 39, Pa.

A 2-POINT SERVICE FOR YOUR POST-WAR HYDRAULIC NEEDS

by ADECO
SPECIALISTS IN HYDRAULICS

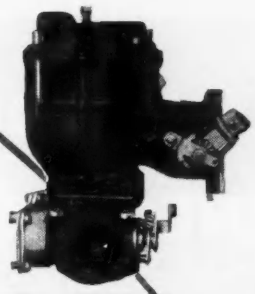
In lining up your post-war schedules, it will pay you to utilize Adeco experience and facilities. These specialists in hydraulics can help you in two important ways:

1. Assist you in designing hydraulic mechanisms to meet your requirements.

2. Work with you in producing precision parts and assemblies on a contract basis.

An illustrated booklet presents the story behind this Adeco service. Write for your copy today.

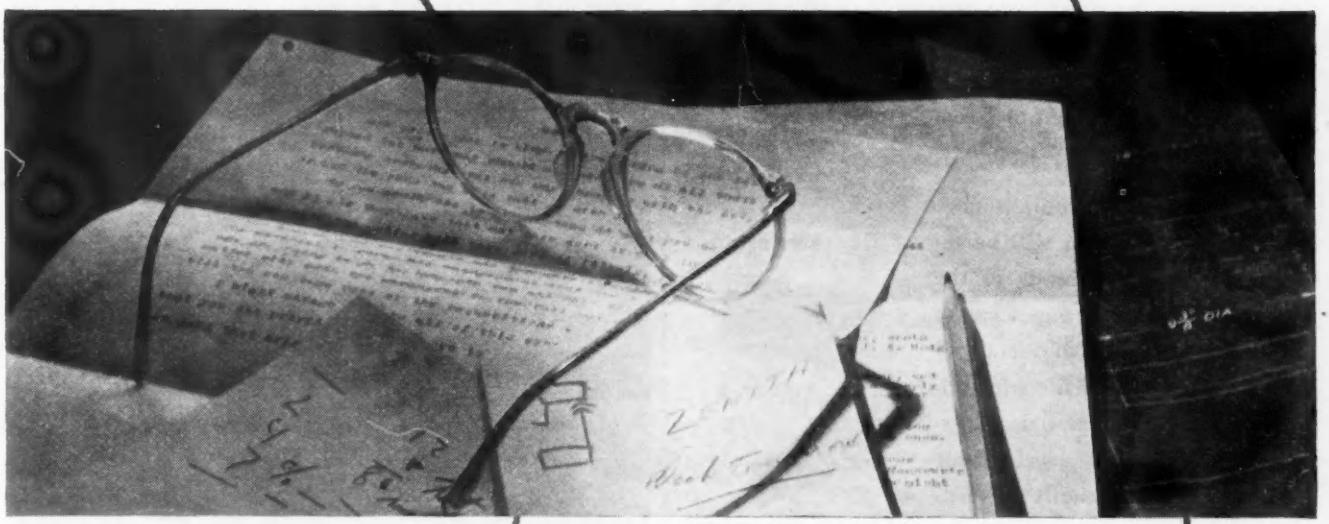
ADECO
AIRCRAFT AND DIESEL EQUIPMENT CORP.
4401 NORTH RAVENSWOOD AVENUE
CHICAGO 40, ILL.
YOUR PARTNERS IN PRECISION



put Zenith's unmatched

line and experience back of

Your Postwar Design

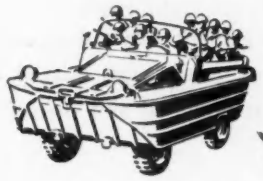


You put the mark of success on the carburetion phase of your designs when you utilize *Zenith's 30 years of specialization in heavy-duty carburetion.*

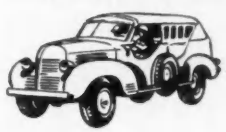
Heavy-duty carburetion is *a specialized field.* It differs widely from standard-carburetion engineering. Only long familiarity with its special problems can serve as a fit background to serve *you* best.

For 30 years—since almost the beginning of the industry—Zenith has been recognized as heavy-duty carburetion headquarters. That's why today millions of America's leading makes of trucks, buses and industrial engines are Zenith-equipped—operating with *greater power, greater economy, greater efficiency.* That's why many farsighted designers are today drawing on Zenith's complete line and unmatched experience.

Design the best into *your* equipment. *Specify Zenith.* There is probably a Zenith design available right now to fit your needs.



Twice proved on the world's toughest proving ground—World War I and II.



ZENITH

CARBURETOR DIVISION OF

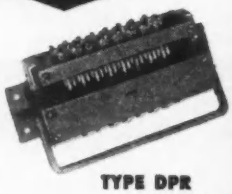
696 Hart Avenue, Detroit 14, Michigan

Bendix AVIATION CORPORATION

LOOK TO CANNON 'DP' CONNECTORS IN 1945

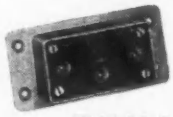
HERE ARE A FEW OF THE 'DP' CONNECTORS AVAILABLE *NOW* AND MANY NEW DESIGNS ARE COMING

NEW applications of the exclusive Cannon Electric "DP" series of connectors have recently been extended from rack equipment in radio assembly to such uses as special centralized aircraft control on through to signal relay equipment.



TYPE DPR

TYPE DP-30



TYPE DP-D

TYPE DP-P10

Several new "DP" connectors of strikingly new design will be released in 1945—testimony to the progressive engineering Cannon Electric incorporates into its products. Since Cannon Electric pioneered the aircraft electrical connector in 1932, this development process has gone steadily onward. Cannon is prepared to meet the demands of postwar electrical equipment.

Cannon Type DP Connectors cover a variety of rack, panel and bail-type fittings, carrying from eight to 135 circuits with amperage range from 10, 15, 30 and 40 in many varied arrangements, including coaxial contacts. All these and many other high quality electrical connectors are Cannon designed and manufactured.

For detailed engineering data on Type DP Connectors refer to the Cannon DP Bulletin. Write to Department A-109, Cannon Electric Development Company, 3209 Humboldt Street, Los Angeles 31, California.

CANNON ELECTRIC

Cannon Electric Development Co., Los Angeles 31, Calif.

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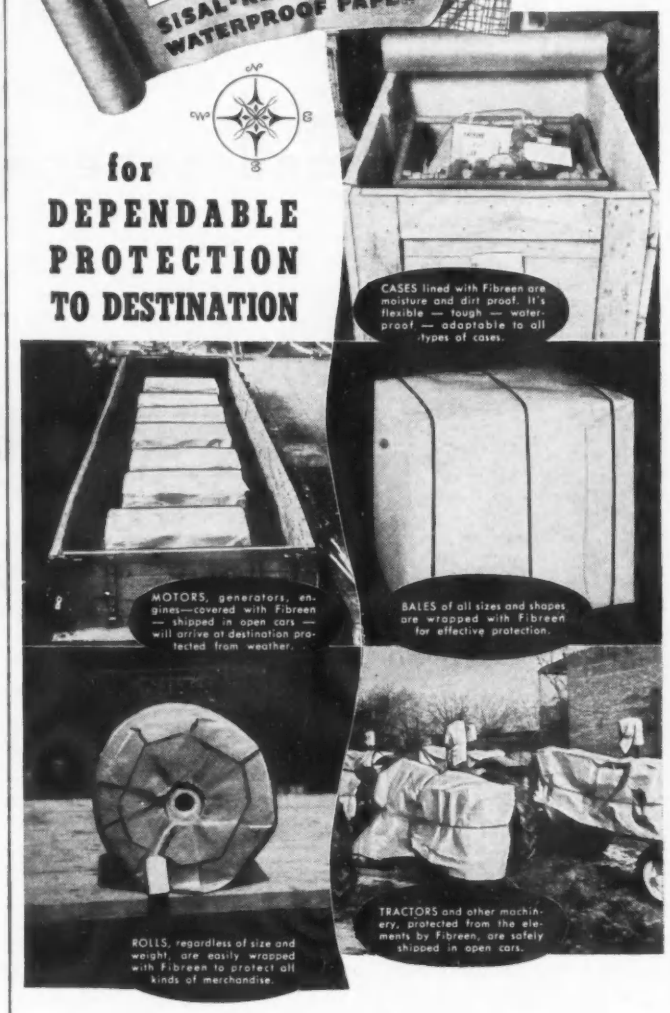
CASES lined with Fibreen are moisture and dirt proof. It's flexible — tough — waterproof — adaptable to all types of cases.
MOTORS, generators, engines—covered with Fibreen — shipped in open cars — will arrive at destination protected from weather.
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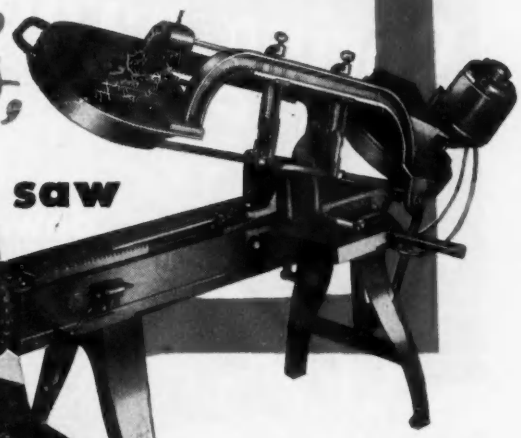
when the *Little Odd Jobs,* need a full time saw



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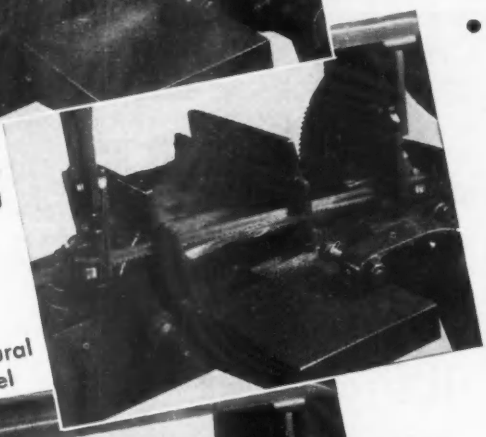
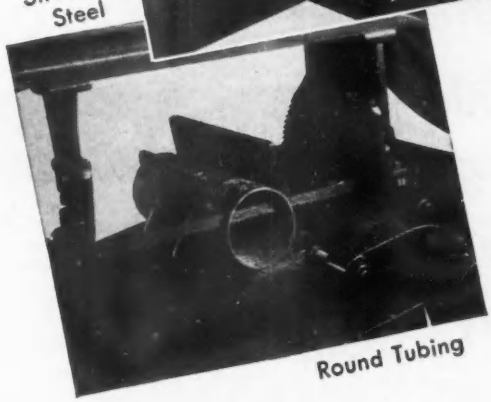
WELLS No. 8

. . . get a *Low Cost, Versatile* WELLS

Sawing Square Tubing



Structural Steel



Round Tubing

A Wells is a handy tool to have around where there are miscellaneous sawing requirements. In the first place it will cut most any metal of any shape you can get into the saw—and it is simple to move about on casters or a dolly. It cuts accurately and efficiently . . . is economical to operate and costs little to buy. Of course, a Wells is a handy production saw too, for steady, continuous work—but it is such a capable all-around cut-off tool that most any plant can use one to advantage. Ask your Supply distributor or write us for complete details.

SPECIFICATIONS:

CAPACITY:	**Retangular . 8" x 16" (Special Guides) . 5" x 24"**
ROUNDS:	**8" diameter**
MOTOR:	**½ H.P. current optional**
SPEEDS:	**Selective 60, 90, 130 ft. per min.**
WEIGHT:	**Approximately 750 lbs.**

Wells SAWS
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METAL CUTTING BAND SAWS

WELLS MANUFACTURING CORPORATION
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Are your mechanical developments in the stage where you are searching for just the right kind of spring? Then call on B-G-R engineers for advice on choice of material, type of action, and correct design—for economy in manufacture and ease of operation. Be guided by B-G-R—it pays!

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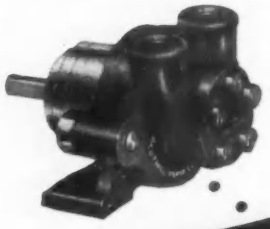
B-G-R PRODUCTS SERVE OUR COUNTRY-ON LAND, AT SEA, AND IN THE AIR



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Precision manufacture speaks for itself in these Tuthill small industrial pumps. Midgets in size, these internal-gear rotary pumps are ideal for lubrication, hydraulic, liquid transfer and coolant service. Save space, material and money. Capacities from .33 to 3 g.p.m. at pressures up to 400 p.s.i. Mechanically sealed. Ring or foot mounting. Write for Catalog on small pumps.

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TUTHILL PUMP COMPANY

939 East 95th Street • Chicago 19, Illinois

Be 100% With 10% • Buy War Bonds

New Bearing Developed

(*Continued from page* 180)

ver-lead combination were tried, and scientists studied their microstructures. Already known was the fact that single-face, copper-lead bearings were easy to make. But to make double-face or "floating" bearings such as connecting rod bearings was more difficult. Segregation of lead was a problem when coating both sides at once. This created weak points.

Ford technicians observed that segregation did not occur when silver was present. Sample bearings were made and experiments were begun. Both in the laboratory and in actual road tests, the new bearings demonstrated superiority over existing types.

Once the bearing was proven, an economical method for its volume production had to be found. Existing methods for casting copper-lead bearings were too costly. However, the company had perfected a novel technique for casting copper-lead bearings 10 years earlier—only to abandon the project following the introduction of the cadmium-coated bearing. Now, a decade later, the technique has been coupled with the new alloy, and the result is a superior bearing.

Today the new bearings are being produced in quantity at the Rouge plant in Dearborn. More than 500,000 are already in service in armored cars, universal carriers, tanks, jeeps, cargo trucks and official cars. Ford has applied for patents covering the "tri-alloy" bearing, while the method and machinery used in their production already are patented.

BOOKS . . . .

The third revised edition of the authoritative text—CAST METALS HANDBOOK, 1944 EDITION—published by the *American Foundrymen's Association* is now off the press. In content it brings up-to-date the existing information on cast steel, cast iron, malleable iron, and the non-ferrous alloys including magnesium, aluminum, and other useful alloys. Supplementing the specific handbook information for each class of metal are sections on recommendations for designers and buyers, as well as a discussion of the significance of strength and ductility tests. Unique feature of the text lies in the fact that it has been compiled, edited and revised by outstanding specialists in the field of metallurgy and foundry practice.

Tool Designing Engineers

BERG ENGINEERING SERVICE

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The "Quality" demanded by Curtis Universal Joint "Standards" gives every user of Curtis Joints a product that meets and surpasses rigid and strenuous wartime needs.

Each part shown has special features — successfully proven in hundreds of applications by airplane and machine tool industries.

Twenty years of experience selecting the right steels, special heat treatments developed by Curtis, careful machining to close tolerances, finished ground surfaces all accurately fitted to give positive, free articulation, are incorporated into each part.

Figs. 1 & 2 FORKS — heat treated to secure maximum toughness and strength, inside ear surfaces accurately ground for close, smooth working operation, pin holes broached and honed for perfect alignment, the O. D. cylindrically ground for concentricity

Fig. 3 CENTER BLOCK — holes intersecting accurately in the center, with the faces parallel, hardened and precision ground for long wear, with recess for the Telltale Lock ring.

Figs. 4 & 5 PINS — hardened and centerless ground to close tolerances reduce radial play.

Fig. 6 OILER — Curtis pioneered proper and essential lubrication, and made it easy by furnishing patented oilers in the large pin.

Fig. 7 "TELLTALE LOCK RING" — patented by Curtis — snaps into small pin groove and fits recess of center block. This insures firm, positive lock-up of entire assembly — makes disassembly and reassembly quick and easy, and the "Telltale" end shows at a glance that the ring is in proper locking position.

Curtis Engineers can help solve your universal joint problems. Our experience and knowledge are yours for the asking.

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BOSTON GEAR WORKS, NO. QUINCY, MASS., SOLE DISTRIBUTORS

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...a manufacturer with a production FINISHING PROBLEM

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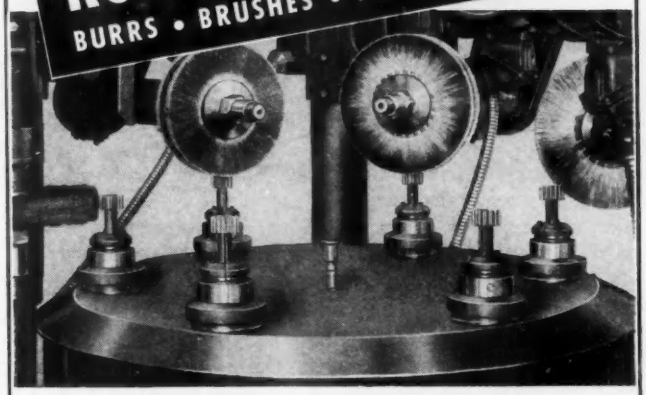
Deburred at the rate of 150 to 200 per hour on a

Hammond ROTARY AUTOMATIC

BURRS • BRUSHES • POLISHES • BUFFS



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HAMMOND high-production 6 and 8 spindle Rotary Table Automatics are standard units engineered into a wide variety of set-ups to do burring, brushing, polishing or buffing operations on a great many items of varying sizes, shapes and kinds of metal.

Illustrated above is a typical finishing operation — the brushing of steel pinion-gears to remove the burrs and finish the edges of the teeth on the outside diameter of the gear, as well as smoothing the sides of the gear and the edge of the bore. 150 to 200 gears per hour are finished complete on both sides.

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Sure, the news is good — terrific, in fact. But don't let that give you the idea that America's paper shortage is over. More paper than ever is needed now to wrap supplies for our armies as they drive toward their goal. There's still a manpower shortage in the pulp industry.

So, you've still got to watch your company's use of paper with the hawk eye of a paper miser. You've still got to use your ingenuity and that of your staff to find even more ways to *use less paper.*

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Remember—
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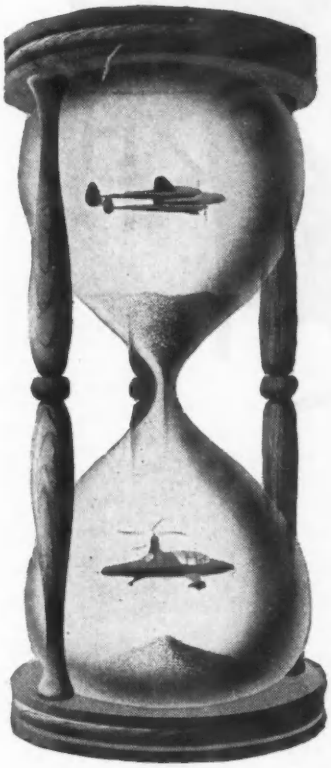
USE LESS PAPER — SAVE ALL WASTEPAPER

This advertisement contributed by this publication and prepared by the War Advertising Council in cooperation with the War Production Board and the Office of War Information.

Every MANUFACTURING CUSTOMER Will Benefit



Industrial users of WILCO Products will find the increased facilities, the new products and techniques developed by WILCO for war service of great advantage to their own postwar products.

As the Hourglass indicates . . . with the coming of peace, many WILCO products now making for precision performance in airplanes, ships, tanks, guns and instruments of the Army and Navy will play an equally important role in meeting civilian needs for hundreds of useful and reliable products.

The demand of all branches of the service for Thermostatic Bimetals and Electrical Contacts has motivated many WILCO developments of great potential value to postwar industry. New Products added to an already extensive line; increased facilities for refining and fabricating precious metals; greatly extended rolling mill facilities—these new additions and improvements, now devoted principally to the war effort, will prove equally helpful to manufacturing customers in meeting their peacetime production and marketing problems.

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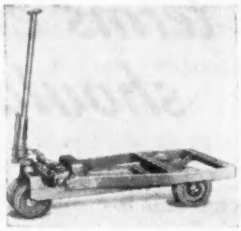
TONS MOVE with FINGER TIP CONTROL

...on the revolutionary HydroLectric Lift Truck!

AGAIN WALTER C. STUEBING TRIUMPHS in lift truck engineering . . . takes the "handling" out of materials handling with the amazing Motorized Hydro*Lectric!* Finger-tip control enables *one man* to do the work of *four.* Revolutionary principles of lift truck construction . . . exclusive patented features set new standards in efficiency and economy.

All the experience and engineering skill of the Stuebings—pioneers since 1910 in lift truck construction—is built into this sensational addition to a notable line. In plants of every size and type, the Hydro*Lectric* is proving its outstanding worth. Give *your* production a lift . . . *lower* your costs. Write today for complete information on the remarkable new Hydro*Lectric.*

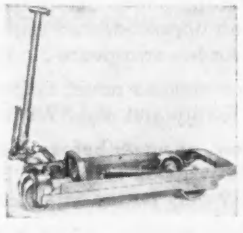


The HYDROMATIC

A multi-stroke Lift Truck combining great lifting capacity with unusual ease of operaton and positive safety. Capacity 3500# to 8000#. Pays for itself in time and manpower saved.

The RED ARROW

A single-stroke Lift Truck with quick automatic action. Easy lift, roll and steer. Automatic safety release. Built like a fine machine tool. Unequalled by any truck of its type.



SEND FOR DETAILED LITERATURE

All the above trucks are engineered and patented by W. Stuebing of Lift Trucks, Inc.

LIFT TRUCKS, INC.
WALTER C. STUEBING, *President*
2425 SPRING GROVE AVENUE . . . CINCINNATI 14, OHIO

LIFT TRUCKS INC. WWW.STUEBING CINCINNATI

Peace terms every man should make NOW!

The war is still on . . . and will be for some time to come.

But right now—before the war ends—every man in America has an unprecedented opportunity to make terms with himself for his own peace . . . his peace of mind.

For *now*, as never before, a man should look at his wife and family and say, "What can I offer them for the future?"

Now, as never before, a man should look at his house and worldly goods and say, "How can I improve these so my family may better enjoy life?"

Now, as never before, a man should look at tomorrow and say, "How can I best prepare for some unforeseen emergency which might affect my family?"

And *now*, as never before, every man in America has a chance to answer all these questions—an opportunity to provide for the future.

That opportunity is War Bonds. No doubt you are buying War Bonds through the Payroll Saving Plan. Arrange to buy *more* War Bonds. All you can afford. *More* than you thought you could afford.

What's even more important—don't cash in those War Bonds before they mature. Stick them away in a safe place—and forget about them till you can reap the full harvest on them.

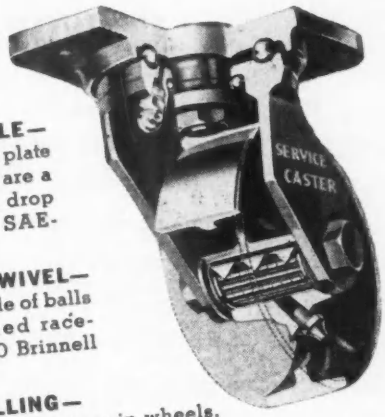
Now is the time to make your plans for peace of mind. It's something you owe yourself . . . owe your family. Buy War Bonds and hold onto them!

This is an official U.S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council

LAST TIME FOR A LONG TIME!

Because This Time He's Replacing With Long-Life Service "ForgeWelds"

● To save time spent replacing casters that just can't stand constant pounding, replace with Service Heavy-Duty "ForgeWelds." You'll replace fewer in the long run. These casters are really tough—built to carry your heaviest loads with no attention except occasional greasing. As an extra dividend, you'll find trucks, trailers and other hauling units moving with new liveliness and speed.



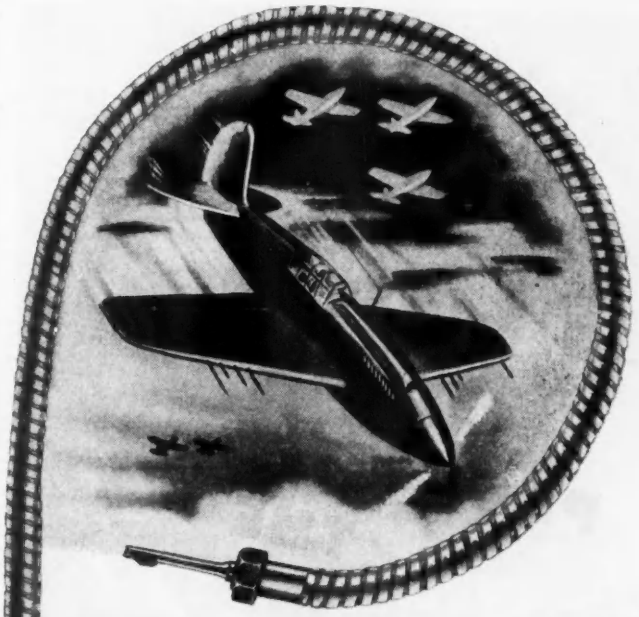
- **UNBREAKABLE—** As shown, top plate and king bolt are a single piece, drop forged from SAE-1045 steel.
- **INSTANT SWIVEL—** Double circle of balls in machined raceways of 230 Brinnell hardness.
- **EASY ROLLING—** Hyatt Roller Bearings in wheels.
- **LUBRICATION:** High pressure type.
- **CAPACITY:** 6,000 to 8,000 lbs. per set of 4.
- **WHEELS:** Your choice of Ni-Steel-Iron or floor-protecting molded plastic.

SERVICE CASTER & TRUCK DIVISION
OF DOMESTIC INDUSTRIES, INC.
676 N. Brownswood Avenue, Albion, Michigan
Eastern Factory: 449 Somerville Ave., Somerville (Boston) Mass.
Toronto, Canada: United Steel Corporation, Ltd., SC&T Co. Division

ARMY E NAVY

SERVICE

Trucks, Casters and Specially Designed Lifting and Hauling Units

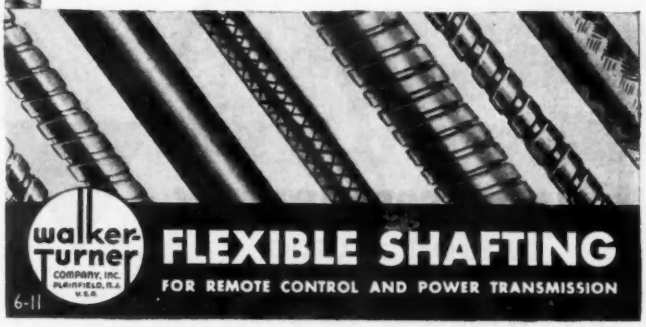


WHEN THE "LONGEST WAY 'ROUND IS THE SHORTEST WAY HOME"... Specify Walker-Turner Flexible Shafting

In transmitting light power loads between two points, it is often possible to design a simpler, lighter, more compact product with Flexible Shafting than with gears.

You'll find, too, that it pays to specify Walker-Turner Flexible Shafting on jobs like these — for smoother power flow, more sensitive control, trouble-free operation. Into this product, we've packed all the "know-how" picked up in years of manufacturing our own flexible shaft machines . . . in years of working with other manufacturers on problems of power transmission and remote control. Let us know if we can put that experience to work for you!

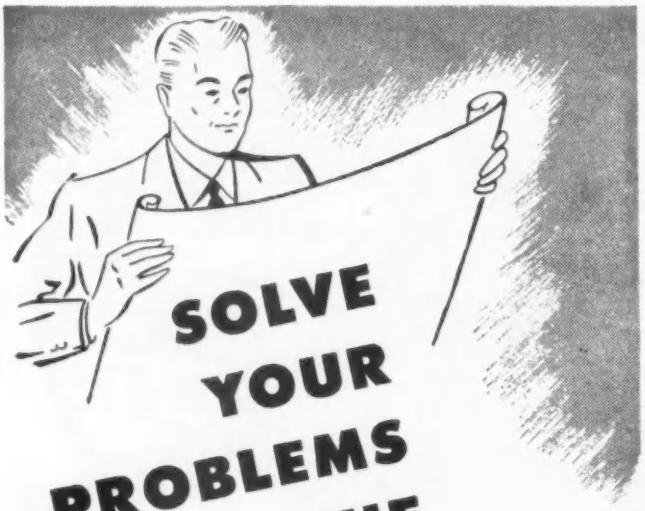
WALKER - TURNER COMPANY, INC.
Plainfield • New Jersey



walker-Turner COMPANY, INC. PLAINFIELD, N.J. U.S.A.

FLEXIBLE SHAFTING
FOR REMOTE CONTROL AND POWER TRANSMISSION

6-11



SOLVE YOUR PROBLEMS THE PLASTIC WAY

Whether you are making battleships or airplanes, pianos or mouth-organs, darning needles or railroad spikes, somewhere, sometime, plastics will enter directly or indirectly into the manufacture of your particular product.

STANDARD MOLDING is aiding in the application of plastics to an ever widening field. STANDARD will make these applications as intelligently as possible, utilizing the best suited materials for the purpose, molded and fabricated in the most modern machinery and equipment available.

The many intricate designs that are evolving around today's productive possibilities in plastics require skill, experience, and versatility, qualities that are found in STANDARD'S engineers. We suggest that you consult STANDARD MOLDING, a pioneer in the injection plastic field, where a complete engineering service by competent injection molding specialists is available.

Mail us your blueprints for a detailed analysis.

THE Standard MOLDING CORPORATION
DAYTON 1, OHIO

PRODUCTION DESIGN SERVICE

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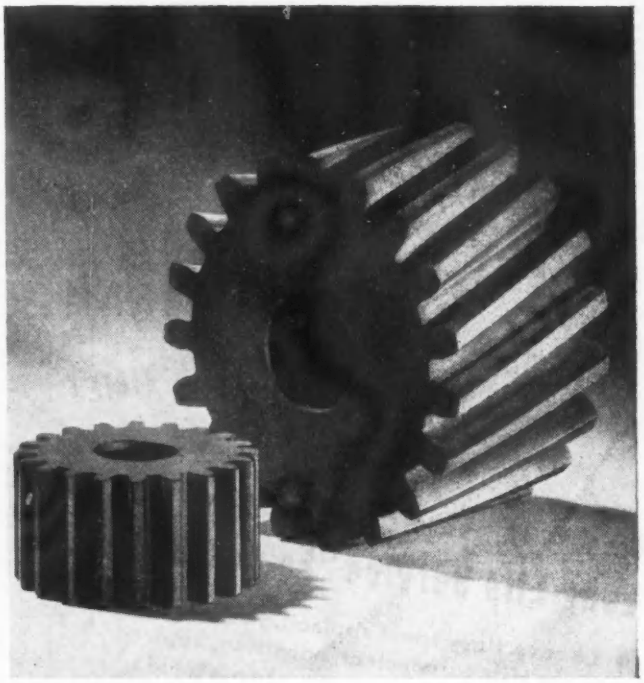
DETROIT—Standard Molding Corp., 6452 Cass Ave.
CHATTANOOGA—Standard Molding Corp., 324 Chattanooga Bank Bldg.



Sh-h-h-h-h-h-h!

TAYLOR SILENT GEARS AT WORK

Taylor Phenol Fabric Gears, meshed with metal gears in the gear train, eliminate noisy, metal-to-metal contact, absorb the shock of tooth impact, lessen gear wear, and, by minimizing vibration, reduce wear throughout the entire machine.

This material is not only strong enough for the heaviest-duty drive, but is so light in weight that it materially reduces the dead load on the drive. These gears are impervious to water, oil, and most chemicals; are not subject to rodent attack; are unaffected by oxidation; and resist the effects of abrasive dust.

Blanks may be machined in the same manner as metal but, of course, much more rapidly and economically. They can be cut to any type of gear. Commercial gear cutters in principal cities maintain a stock of Taylor Silent Gear blanks in various sizes—or write us direct about your requirements.

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Sheets, Rods, Tubes, and Fabricated Parts
NORRISTOWN, PENNSYLVANIA • OFFICES IN PRINCIPAL CITIES
PACIFIC COAST HEADQUARTERS: 544 S. San Pedro Street, Los Angeles

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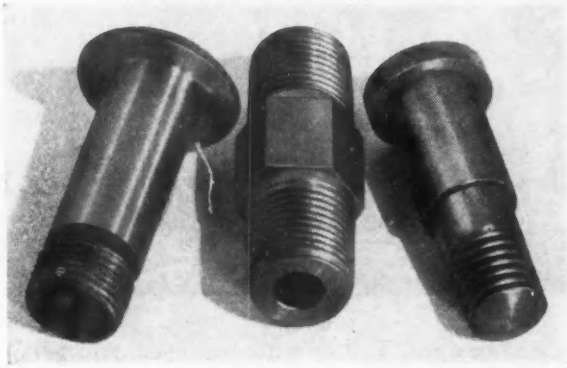

SPECIAL BOLTS AND STUDS

Uniform in strength, with precise, clean cut threads, and forged heads of any type or shape, RITCO Special Bolts and Studs can be made in any metal . . . ground or unground . . . in sizes up to 2" diameter. We are regularly supplying special bolts to fill the needs of the aircraft, marine, automotive and many other industries.

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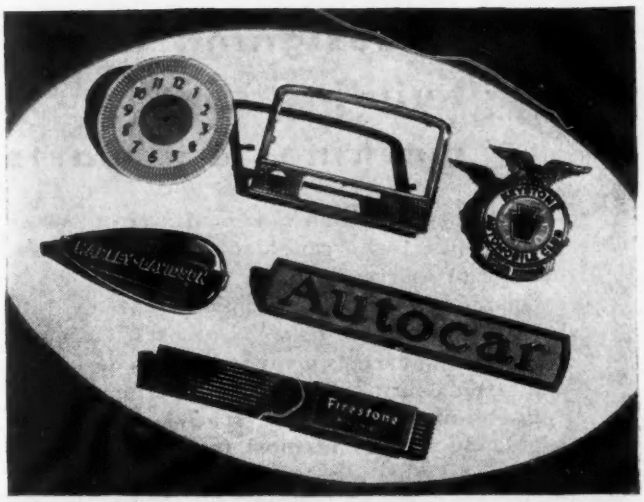

GRAMMES decorated metal products with their beauty of design, color, and finish help give your products greater salability. We're specialists in designing and producing distinctive Name Plates, Escutcheons, Dials, Trim Pieces, Bezels, and *precision* stampings.

With 69 years of precision fabricating skills, cleverly devised assembly methods, and broad "know-how," Grammes can save you time, money, and materials on your parts or product. The facilities listed provide a *centralized* set-up for efficient and economical precision fabricating and assembling.

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Operating on this principle, MERZ has not limited the scope of its work to a few standardized items, but serves many industries, designing and manufacturing all types of experimental and "pilot model" equipment, special parts, tools, gages and fixtures of most intricate and complicated designs. Tell us what you need, and get our suggestions.

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Every car and truck owner in America is vitally interested in adding longer life to their vehicles.

Every serviceman in America is endeavoring to have these cars and trucks make the "home-stretch" between now, and when new vehicles again become available.

Simplex Rings will prolong the life of car, truck or tractor, providing economy of operation and the satisfaction of knowing that the engine is in perfect running condition for a long time ahead.

Simplex Rings are a quick, positive remedy for oil pumping and compression loss . . . and when the job's done there's no "come-back" headache.

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CMP Precision makes manufacturing processes easy to control, protects dies and intricate machinery, and guarantees to your consumers a uniform product.

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THE COLD METAL PRODUCTS COMPANY

Subsidiary of the Cold Metal Process Co.

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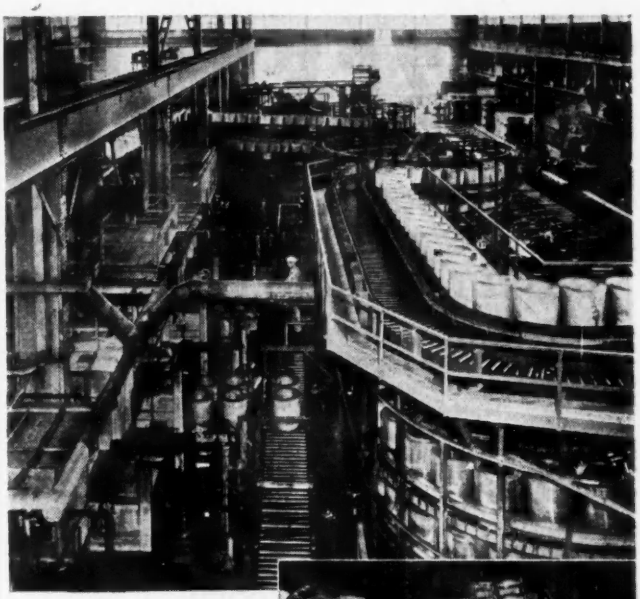

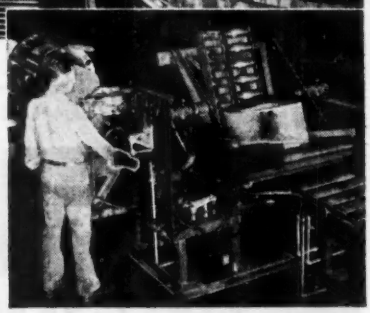

PUT MATHEWS METHODS INTO YOUR POST-WAR PLANS

The need for special devices in conveying systems, increased during these war years of fast and tremendous production, has found Mathews Engineering ready and eager for the job. Frequently, the conveying problems have been entirely new. Always, they have been different in some respects from even the most similar jobs in the past. The conveyers were needed quickly and the need was great. To meet this need, Mathews Engineers and production personnel have hammered away steadily, meeting these problems as they came, and solving them. As a result of this activity — these new problems — these special devices which were developed—many years of experience have been packed into a short while. That is why Mathews methods are up to the minute. This experience is available, through the Mathews Field Engineer, in all principal cities in the United States and Canada.

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SINCE 1896 **GASKETS**

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Yes.. WE CAN NOW ACCEPT EXPERIMENTAL WORK.....!

WITHOUT interfering with war work, we can now accept the machining of experimental parts for peacetime products—also production work involving the machining of small lots of parts to close tolerances.

● ***Write Us Concerning Your Requirements!***

GOVRO-NELSON CO.
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Built to blast their way over shell torn hills and through reef rimmed seas, Buffalo tractors have inspired surer footed designs for post war tractors. And the rugged service demanded of the clutches in these pitching, plunging Buffaloes has developed battle - proved types of clutches that will make peacetime tractors better able to overcome the toughest going.

ROCKFORD *OVER CENTER and SPRING-LOADED* CLUTCHES POWER TAKE-OFFS

SEND FOR THIS HANDY BULLETIN ON POWER TRANSMISSON

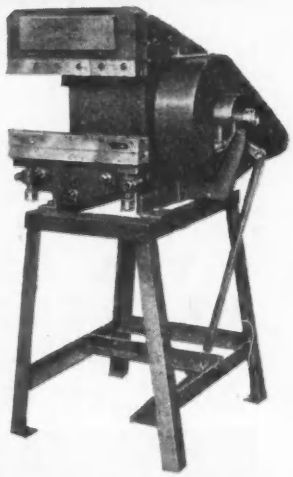
It shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications. Every production engineer will find help in this handy bulletin, when planning postwar products.

Rockford Drilling Machine Division
Borg-Warner Corporation
315 Catherine Street, Rockford, Illinois, U.S.A.

WHITNEY-JENSEN PRODUCTS
30 YEARS EXPERIENCE

18" PRESS BRAKE

CAPACITY 14 GA. IRON
47 STROKES PER MIN.

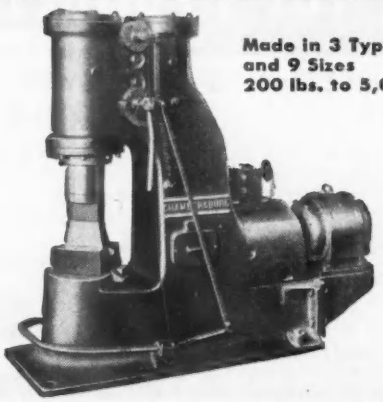


Specially designed to meet the need for a small power-driven press brake for moderate-sized work in jobbing and production shops. Specifications include 1" length of stroke, 1" adjustment, 1 h.p. motor, 11½" throat height, 6¼" throat depth. Ram and die shoes are machined to take standard ½" tongues. Powerful, extremely sturdy, fast, easy to adjust, accurate, with many practical features.

No. 17 BENCH PUNCH

Easy to operate, with smooth roller bearing action. Very practical where work is of a varying nature. Capacity ¼" hole in ¼" iron. Depth and side gauges furnished. 6" x 8" work table available.

WHITNEY METAL TOOL COMPANY
190 FORBES ST. • ROCKFORD, ILL.



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200 lbs. to 5,000 lbs.

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Self-contained motor compressor and hammer in one unit. Anti-friction bearings, clean, low-center-of-gravity construction, improved long ram guides are valuable features. Its greater forging output is due to its heavier anvil construction, higher impact speeds and greater rapidity of blows.

Further details in Bulletin No. 1275

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PORTABLE POWER SAW AND FILE

- CUTS ALL METALS—WOOD—PLASTICS
- SAWS AND FILES IN INACCESSIBLE PLACES
- OPERATES BY ELECTRICITY—FLEXIBLE SHAFT—AIR
- SIMPLE AND EASY TO USE—LIBERALLY GUARANTEED

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ACTUAL SIZE

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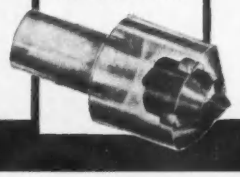
Equip Now with "RE-SET-ABLE"
Diamond Tools on Your Precision Grinding Production Line



DIAMOND TOOL COMPANY, Not Inc. SHELDON M. BOOTH, Pres. 938 E. 41st Street CHICAGO 15, Ill.

AIRCRAFT TEMPERATURE CONTROLS
for Today and Postwar

hi-g Temperature Controls offer unique advantages to aircraft designers and manufacturers now and in the postwar period. These controls operate flaps on airplanes. They reduce the human element in such operations. They provide all **hi-g** benefits because they operate in any position regardless of vibration, change of motion or acceleration. Operating hydraulically, they give instant response on liquid or air-cooled engines. If you have a temperature control problem, write us.

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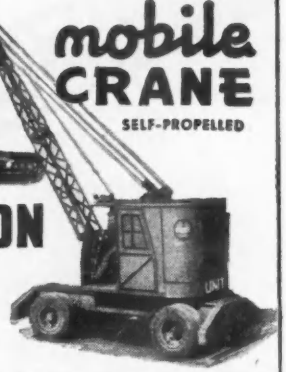
UNIT 5 TON mobile CRANE
SELF-PROPELLED



Powerful, fast-stepping Mobile Crane . . . one-man operated . . . for "on and off" highway operations . . . simple to operate . . . (eliminates cut-up terrain, mutilated concrete docks and runways.)

Write for particulars.

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35,000 R. P. M.
Weighs only
35 oz.

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Precise

THE PRECISE 35

CHAMBERSBURG HIGH FRAME GUIDED RAM FORGING HAMMER

Provides greater working space than any other Single Frame Guided Ram Hammer.

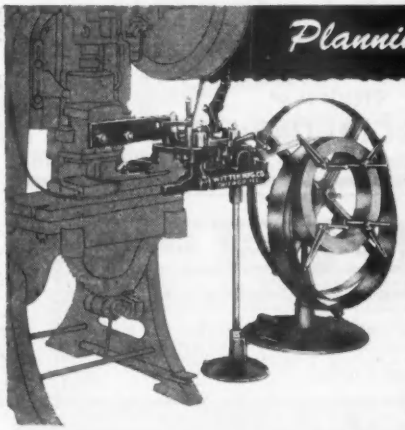
It is now possible to forge large discs and rings, to upset high stems, form arch bars, etc., on the most economical size of tool. Long punching with drifts is facilitated. • Guides are supported on 5 sides to preserve alignment, and rigidity is further assured by tie-bar across frames.

Fully described in Bulletin No. 211-F

CHAMBERSBURG ENGINEERING CO., CHAMBERSBURG, PA.

CHAMBERSBURG
HAMMERS • PRESSES • CECOSTAMPS

Planning Peacetime Production Using Coiled Strip Stock?



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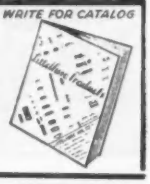

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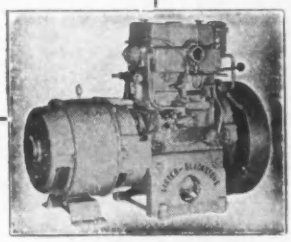

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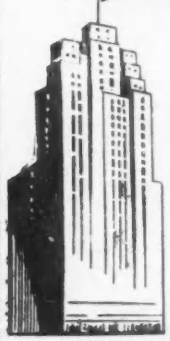

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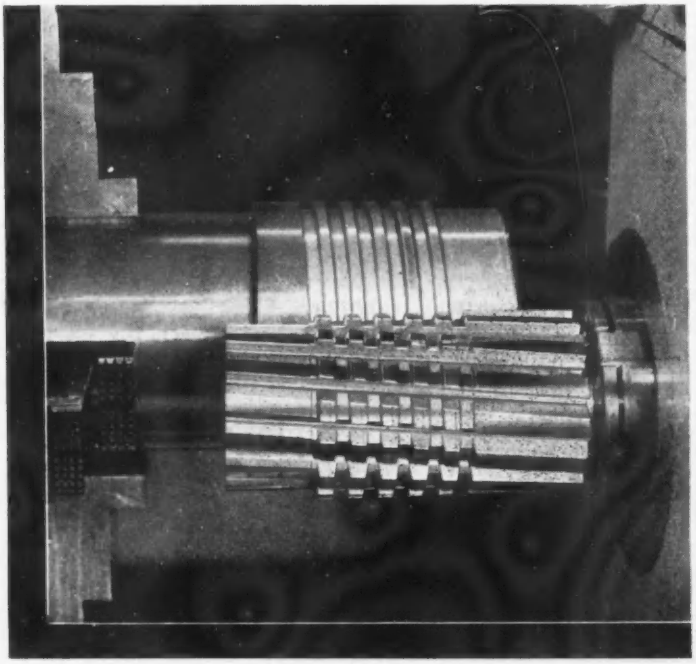

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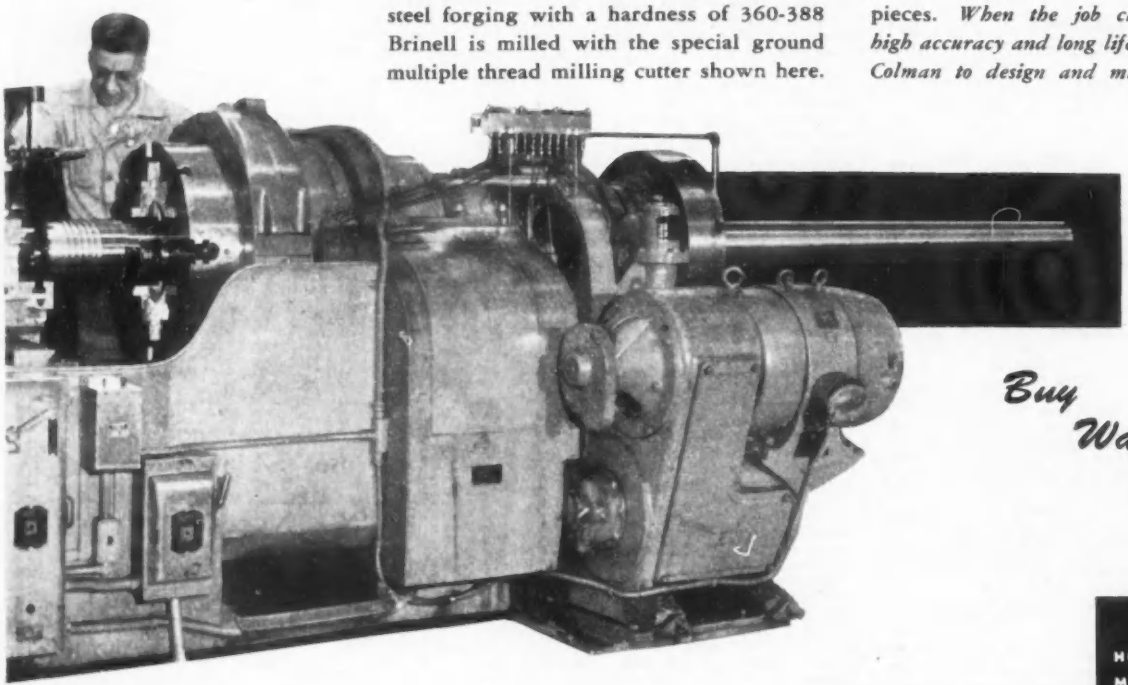
Milling threads on 76 mm. gun barrels proved to be faster and more dependably accurate than was possible with the turning method formerly used. Barber-Colman engineers contributed cutter design to the improvements gained in this change of method. This gun barrel of tough alloy steel forging with a hardness of 360-388 Brinell is milled with the special ground multiple thread milling cutter shown here. Accuracy limits call for ±.0005" cumulative on pitch and ±.00025" on depth, with excellent finish required. Two cuts are taken, removing .205" at 45 r.p.m. cutter speed and .055" at 25 r.p.m. Feed is 1.047" per min. Each cut requires 32 min. and the cutter is sharpened after each 49 completed pieces. *When the job calls for cutters of high accuracy and long life, count on Barber-Colman to design and make them for you!*



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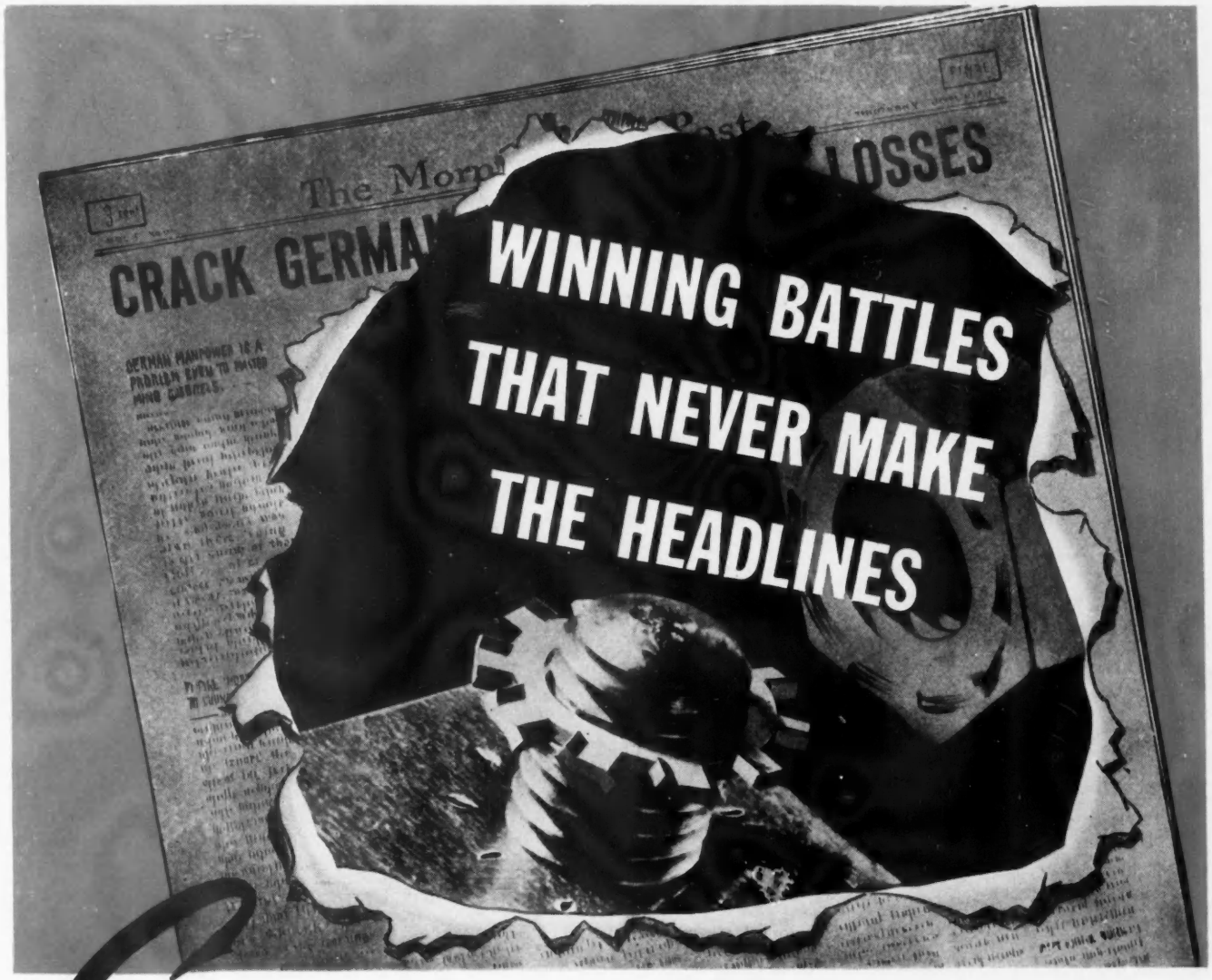

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